THURSDAY, SEPTEMBER 30, 1880

LANDSLIPS

FEW disasters impress the mind so vividly with human helplessness as those that arise from disturbance of the solid ground beneath our feet. The most devastating hurricane can in some measure be foreseen and provided against. Skill and foresight continually do battle with the fury of the waves, and prove on the whole victorious. We are so familiar with the restlessness of air and ocean that the havoc wrought by these elemental powers does not carry with it the sense of aught unusual or against which we may not hope successfully to contend. But to find that the earth beneath us, to which we have, consciously or not, trusted as the only stable feature in our landscape, gives way in a moment of unsuspicious calm, that the everlasting hills are themselves perishable like everything else, that ruin and death may in an instant overwhelm alike scenes of sylvan quiet and of active human industry, brings to the mind that practically experiences the sensation a horror to which there is hardly any parallel in the long list of calamities that thin the ranks of mankind.

Terrestrial commotions of this nature are obviously divisible into two classes. There are first tremors, of which the far-reaching and destructive earthquake is the most signal example. Much has been said and written about the cause of earthquakes, but we are still far from a satisfactory solution of the problem. Probably more causes than one conspire at different times to produce the impulse which sets the earth-wave in motion. But whatever may be their nurture and origin, these operations belong to that large class in which the internal temperature of the planet, with the results of its reactions and its diminution is the chief factor. In the second place come the disturbances arising from the working of the different agents which are set in motion by the direct influence of the sun. Among these the operations of running water are by far the most important.

There can be no doubt that it is in this second class of phenomena that the melancholy catastrophe at Naini Tal must be placed. In various ways the action of running water disturbs the equilibrium of large masses of rock at the surface. The frequent undermining of its banks by a rivulet or river, with the consequent fall of slices of earth or rock into the stream, is a familiar illustration. The dislocation and dislodgment of portions of cliffs by the wedging influence of frozen water is another common example. But the most extensive changes of this kind arise from the influence of water underneath the surface, where the geological structure of the ground happens to be favourable. Trickling through the pores, joints, and fissures of rocks, rain or melted snow makes underground channels for itself. In the course of its progress it sometimes dissolves away large quantities of stone, or loosens and carries away in mechanical suspension the minuter particles of rocks. When this abstraction of materials takes place along a subterranean slope, the lower end of which comes out on the side or bottom of a valley, the effect is to enfeeble the support of the mass of rock resting upon the slope. Eventually this overlying mass may by gravitation break off from its floor and slide down into the valley below. Or should an open porous layer form the platform on which the side of the valley or cliff rests, copious rain may so saturate it as to loosen the cohesion of the superincumbent mass, which, when its weight overcomes that cohesion, is launched forward into the low ground below it. The saturated stratum may be compared to the grease put upon the beams on which a ship is launched from the building-yard. The moisture lubricates the bottom of the overlying rock and allows it to slide down. Such "landslips," as they are termed, are of common occurrence in countries with a copious rainfall, where the ground is uneven and rests on rocks containing easily permeable strata intercalated among others of a more impervious kind. The dislodged mass rushes down with irresistible impetus, breaking up into tumultuous piles of ruin, under which woods, meadows, gardens, fields, houses, and their inhabitants are almost instantly overwhelmed.

Every summer tourist whose wanderings have led him round the coasts of these islands is doubtless familiar with tracts of landslip, some comparatively recent, others so ancient as to go back far beyond the times of tradition or of local history. He will remember how in localities where the scenery would otherwise be of the tamest kind, the ground has been thrown into picturesque knolls and crags, with little glens and valleys winding through them, how the gathered drainage tumbles over miniature falls or collects into diminutive tarns which, in all save size, remind him of mountain lakes, and how over the whole scene the kindly hand of nature has spread her verdure, healing the scars of the original catastrophe by hanging festoons of ferns and mosses over the shattered rock, smoothing and carpeting with velvet turf the once naked floors of loose detritus, and scattering over dingle and den a pleasant shade of copsewood. The under cliffs of the Isle of Wight and other parts of the south coast, the clay cliffs of Sheppey and Yorkshire, the northern sea-front of the Antrim coast, the shores of Skye and adjacent islands of the Inner Hebrides furnish admirable illustrations of every stage in this history, from the raw wound of last year to the fairy-like scenery which conceals the landslips of remote centuries.

Fortunately in Britain we have no harrowing chronicle of human death connected with the story of our landslips. Yet these have not been without occasional loss of life, and sometimes considerable destruction of property. It has been estimated that the coast of Yorkshire between Spurn Point and Flamborough Head loses about 2¼ yards annually, slice after slice of the clay cliff slipping down to the beach, where it is readily attacked and removed by the waves. The clay cliffs of the Isle of Sheppey suffer similar rapid removal, while the chalk cliffs of the Isle of Thanet have had a yearly loss of three feet. From fields that were ploughed and sown with corn in spring segments slip down, so that in these detached portions the crop may be seen ripening half way down the cliff. In the well-known landslip of December, 1839, near Lyme Regis, a strip of chalk cliff three-quarters of a mile long, 240 feet broad, and from 100 to 150 feet high was undermined by the descent of continuous heavy rain and the saturation of a thick deposit of loose sand underneath. It consequently slid

bodily forward on the beach, breaking up into segments in its progress, and carrying fields, trees, and houses along with it. Unquestionably the most appalling disaster of the kind which has happened in recent times was the celebrated Fall of the Rossberg in 1806, a mountain lying behind the Rigi, and composed like it of sandstone and conglomerate. In this case also there had been much previous heavy rain, which, filtering along a porous sandy bed inclined at a steep angle towards the valley, undermined the support of the overlying thick sheet of massive conglomerate. The whole hill-side gave way and several villages and hamlets, with somewhere between 800 and 900 people, were buried under the ruins. To this day the scar on the slope of the mountain is unhealed, and the piles of huge angular blocks, even to the further side of the valley, remain as memorials of the homesteads and villagers that lie buried below.

The recent catastrophe at Naini Tal is another illustration of the same geological process. The locality is situated on the soft Tertiary deposits which flank the sub-metamorphic and more ancient crystalline rocks of the Himalaya range that towers behind. It possesses one of the few known sheets of water on the Himalayan slopes, nestling among irregularly shaped hills. There is every reason to believe that these hills have derived their present contour not only from extensive denudation by the heavy rainfall, but also from the operation of former landslips, and that the lake itself, to which the place has owed so much of its attractiveness, lies in a hollow formed by the same cause. It has been suggested that the late accident arose from the cutting of a roadway along the base of the hill. But this seems an altogether improbable and unnecessary supposition. The structure of the ground is itself sufficient to account for landslips, apart altogether from the mere superficial interference of any road-making. According to the telegraphic reports there had been a particularly heavy rain, no less than twenty-five inches having fallen in forty hours. The annual rainfall at Naini Tal is stated to be ninety inches, so that more than a quarter of the whole yearly rain fell in less than two days. But this year, at least, the rainfall must have been greater, for Mr. Commissioner Taylor, who was charged with the care of the roads in the district and met his death in the recent catastrophe, wrote on August 17 last that eighty inches of rain had fallen in the previous two months. By such a violent downpour the loose soil is swept off the surface, deep gashes are cut down the slopes, and every streamlet and river is converted into a torrent of liquid mud. But the furrowed soils and rocks likewise absorb much moisture. The water launched in such a deluge over the ground soaks at once into the more permeable gravelly layers and saturates them. When these are inclined towards lower ground and covered with heavy masses of earth or rock, the conditions for the production of landslips are supplied to the full. And such seems to have been the case in this melancholy Indian disaster.

The question arises, Can any steps be taken to guard against a repetition of the calamity? We may take it for granted that Naini Tal, in spite of its recent visitation, will continue to be a favourite resort from the arid plains below. The chance of an occasional destructive landslip will not deter men from coming year after year to gain renewed health and rest in the pure air of these uplands. It is obviously impossible to prevent landslips, except such minor falls as could not do any extensive damage. The only resource is to fix the sites of stations and houses on such spots as will either be free from risk of accident or on which the risk will be reduced to a minimum. This is mainly a geological question, but it is evidently one of the utmost social importance. Among the able staff of the Geological Survey of India there is no doubt an officer whose services could be made available to examine and report upon the structure of the ground at Naini Tal with special reference to this question. There ought to be first a careful inquiry into the details of the causes that led to the recent sad event, and with the experience thus gained a further inquiry into the safety of the other parts of the settlement and of other hill-stations similarly placed. Even in a district liable to destructive landslips sites for houses can probably be so chosen and defended as to be practically exempt from liability to such calamitous visitations as that which we now so heartily deplore. The prodigious amount of rain which in a few days or hours deluges the ground in these regions presents an engineering problem which demands actual Indian experience on the part of those who would successfully grapple with it. Neither geologists nor engineers accustomed only to the comparatively mild rain-storms of Europe can probably realise the magnitude of the difficulty which such disasters as that of Naini Tal presents for their consideration.

ARCTIC NEWS

THE past week has been an unusually interesting one so far as Arctic matters are concerned. First of all we have tidings of the return of the Franklin Search Expedition, sent out from the United States about two years ago, to follow up and unearth if possible some important relics of the Franklin expedition, said to exist among the Eskimo. It may be remembered that upwards of two years ago news reached this country that Mr. Barry, the mate of an American whaler, was told by some Nechelli Eskimo whom he met at Whale Point, Hudson's Bay, that some spoons with Franklin's crest upon them, possessed by the Eskimo, were received from a party of white men who passed a winter near their settlement, where they all died; and that these men left a number of books with writing in them, which were buried. The tale seemed very doubtful, and those best acquainted with the history of Franklin search expeditions considered that it was scarcely necessary to act on the gossip of the Eskimo. However, the people of the United States, who have all along manifested a generous enthusiasm in behalf of the Franklin expedition, thought otherwise, and by private enterprise an expedition was sent out in the summer of 1878, under Lieut. Schwatka, to follow up the traces indicated by the Eskimo. This expedition, after an absence of two years, has just returned, and although the success, so far as its immediate object is concerned, has not been great, it has evidently been able to make important additions to a knowledge of the condition of the inhospitable Arctic region traversed, a region rendered classical, if not sacred, by the early and terrible work of Franklin him-

self. The following telegram in the *New York Herald* of September 23, from New Bedford, Massachusetts, was the first announcement of the return of the expedition :—

"The Franklin Search Expedition, under the command of Lieut. Schwatka, have returned here. They have discovered and brought southward relics of the two British ships *Terror* and *Erebus*, which sailed from London, under Sir John Franklin, in May, 1845. The expedition successfully withstood the greatest amount of cold ever encountered by white men. During sixteen days of a sledge journey, extending over a period of eleven months, the average temperature was 100° below freezing point. In the summer and autumn of 1879 the expedition made a complete search of King William's Land and the adjoining mainland, travelling by the route pursued by the crews of the *Erebus* and *Terror* in retreating towards Back's River. They burnt [? buried] the bones of all remaining above ground, and erected monuments in memory of the dead. Their researches have established the fact that the records of the Franklin Expedition are beyond recovery. They have also learnt that one of Sir John Franklin's ships drifted down the Victoria Straits, and was unwittingly scuttled by the Eskimo, who found it off Grant Point in 1849. The expedition have brought away the remains of Irving, the third officer of the *Terror*. From each spot where graves were found a few tokens were selected which may serve to identify those who perished there. They also secured a board which may be of use in identifying the ship which completed the North-West Passage."

A few further details have appeared in the subsequent numbers of the *Herald*, but we must await the arrival of the paper and the publication of Lieut. Schwatka's narrative for full details. Particulars, we are told, are given of the sufferings and hardships endured by Lieut. Schwatka's party, who, however, succeeded in discovering relics of the expedition, and learnt from the natives details of the sufferings it underwent from cold and starvation. The natives related that they saw a small party of officers, believed to be the last survivors of the expedition, black about the mouths and with no flesh on their bones, dragging a boat across the ice. They then disappeared from view, and their skeletons were subsequently found under the boat and in a tent, a prey to wild beasts, and affording evidence that some of them had been eaten by their comrades. Lieut. Schwatka's own party, we are told, made a sledge journey of over 2,819 geographical miles, mostly across unexplored country, and this constitutes the longest sledge journey on record, both as to time and distance; the men it seems lived like the natives.

The sad story of the terrible suffering endured by 105 men who quitted the *Erebus* and *Terror* on April 22, 1848, ten months after the death of Franklin, is too well known from the narrative of the search party in the *Fox* under M'Clintock. Ample evidence was found scattered along the shores of King William's Land and Boothia, by which they endeavoured to reach the Fish River Settlements, of the fate of most of the party, many of whom, the Eskimo told M'Clintock, fell down as they walked, and had to remain unburied. Lieut. Schwatka's party have done what they could to show respect to what remains of the brave and unfortunate band. Unfortunately no written records of the expedition have been found; there was little room to expect that there would. As to the statement about the vessel which completed the North-West Passage, we suppose this must mean that one of the ships had drifted south-westwards so far as to meet with the furthest eastward point reached by Franklin in his earlier expeditions. The records of temperature will be eagerly looked for by meteorologists; the degree of cold seems to have far exceeded any Arctic temperature on record.

An unfortunate set-off to Lieut. Schwatka's successful return is the news that Capt. Howgate has been again compelled to put back in the *Gulnare* to St. John's, Newfoundland, the vessel being so unsuited for her work that the proposed expedition to Lady Franklin Bay has had to be abandoned for this year. Capt. Howgate is certainly very unfortunate in his Arctic scheme, though we trust he will not be daunted, but will next year be able to accomplish the foundation of his Polar colony.

Further sad news comes from San Francisco of the Gordon-Bennett expedition in the *Jeannette*, which set out full of hope not long ago. No tidings can be obtained by the whalers of the expedition, and the relief steamer *Corwin* had to return owing to the severity of the weather. There is however no more reason for giving up hope than there was in the case of the Payer-Weyprecht expedition, which disappeared suddenly off the Novaya Zemlya coast in 1872, and returned about two years later with the tidings of the discovery of a new Arctic land. This land, Franz Josef Land, a telegram from Hammerfest informs us, was visited in August by that most daring of yachtsmen, Mr. Leigh Smith. He explored to the west as far as 45° E. and 80° 20′ N., and sighted land from that point about forty miles north-west. No doubt Mr. Leigh Smith's experience this year and Capt. Markham's in the same direction last year, seem to point out that exploration northwards on the basis of Franz Josef Land is hopeful. So long as such exploration is carried on by private enterprise there can be no objection to it, but if Government has any funds to spare for Arctic work during the next few years, they would be expended to the best advantage in enabling this country to join the European and American concert for the establishment of Polar observing stations, from which England is conspicuously absent.

RODD'S BIRDS OF CORNWALL

The Birds of Cornwall and the Scilly Islands. By the late Edward Hearle Rodd. Edited, with an Introduction, Appendix, and brief Memoir of the Author, by James Edmund Harting. With Portrait and Map. (London : Trübner and Co., 1880.)

THE addition of another volume to the already long series of works upon the local avifaunas of Great Britain is not perhaps an event of any very great importance as regards ornithology in general. Yet the name of the late Mr. Edward Hearle Rodd of Penzance is so well known to British naturalists, and the county in which his observations were made is a land of such special interest, that there can be no doubt of the present volume being acceptable to a wide circle of readers.

At the time of his death it was generally understood that Mr. Rodd had in preparation a general work upon the birds of his native county. This work, however, as we are now informed by Mr. Harting, had only so far advanced as to "consist of a transcript of various notes on the ornithology of Cornwall, communicated by the author to the pages of the *Zoologist* arranged in chrono-

logical sequence." "It was obvious," Mr. Harting remarks, "that in order to render these notes of practical utility it was necessary to re-cast and re-write the whole." This has been ably executed by the editor, and we have now Mr. Rodd's interesting and original observations, which were continued over a period of nearly forty years, reduced into method and order. These observations, thus re-arranged, occupy the first portion of the present volume, and constitute the most important part of it. Appended to it are more or less contracted reprints of the "yearly reports" which Mr. Rodd was for many years accustomed to contribute to the *Journal* of the Royal Institution of Cornwall, containing an account of the principal ornithological rarities which had come under his notice in each year, and of the additions thus made to the list of the Cornish avifauna. The editor has also considerably increased the value of the volume, especially to Cornish naturalists, by his Introduction. In this is given an account of the previously existing literature on Cornish ornithology, beginning in 1478 with the *Itinerary* of William of Worcester and continued down to the present period, and constituting a most useful summary of information on the subject. Mr. Harting has likewise appended a list of Cornish and provincial names, which will further increase the interest of his work.

The extreme southern and western situation of Cornwall renders it one of the first resting-places in spring and one of the last in autumn of those birds which visit us during the summer migration, whilst several well-known Continental species, which are scarcely ever found in the more eastern parts of Great Britain, occur more or less regularly in this remote county. The black redstart, for example, so little known to the majority of English observers, except in its native haunts in Rhineland and Switzerland, is "not uncommon" in Cornwall in the winter months, though usually met with in immature dress. An adult male, however, in very beautiful plumage was captured in December, 1856, in the immediate neighbourhood of Penzance. Another much less-known European passerine bird, which has been met with in no other part of the United Kingdom, straggles occasionally into Cornwall—curiously enough, as it is essentially an eastern species, and might be rather expected to occur on the coasts of Norfolk and Suffolk. This is the little red-breasted flycatcher (*Muscicapa parva* of Bechstein), of which a single example in immature plumage was obtained near Falmouth in 1863. Two other specimens of the same species were subsequently captured in the Scilly Islands. Eastern Europe, as we have already observed, is the true home of this little bird, which will be well known to such of our readers as have visited Constantinople, where it is very common in autumn among the old walls and ruins.

Another very interesting visitant to the coasts of Devon and Cornwall is the Greater Shearwater (*Puffinus major* of Faber). This species is also well known on the Scilly Islands, where it goes by the singular name of "Hackbolt." Its congener, the Manx Shearwater (*Puffinus anglorum*), is still more common on the Cornish coast, and breeds in some of the Scilly Islands. But for details on these and other peculiarly western birds we must refer our readers to Mr. Rodd's volume, which no student of the British Ornis should fail to add to his library.

DEEP-SEA SOUNDING AND DREDGING

United States Coast and Geodetic Survey, Carlile P. Patterson, Superintendent. A Description and Discussion of the Methods and Appliances used on Board the U.S. Coast and Geodetic Survey Steamer "Blake." By Charles D. Sigsbee, Lieut.-Commander, U.S.N. Pp. 192, xli. Plates. (Washington: Government Printing Office, 1880.)

THE publication of the "Depths of the Sea" and of the "Voyage of the *Challenger*" by Sir Wyville Thomson has made the public familiar with the work of the English in the exploration of the depths of the ocean. But little is known, even in America, of the important part which the United States Coast Survey has taken in the solution of the problems of the physical geography of the sea. The Coast Survey during the superintendence of Prof. Bache instituted a series of investigations on the physical problems of the deep sea, connected with the Gulf Stream, which have little by little been expanded by his successors, Prof. B. Peirce and the Hon. Carlile P. Patterson, into the most important hydrographic exploration yet undertaken by any government. With a wise liberality secondary hydrographic scientific problems, mainly of interest to the biologist and geologist, have been made a part of the work of the Coast Survey. Thus since 1866 the use of the dredge, the trawl, the tangles, and of all the apparatus necessary for a thorough exploration of the fauna of the depths of the sea has become as familiar to some of the navy officers attached to the Coast Survey as the use of the sextant or of the lead.

The Coast Survey steamers, *Bibb*, *Hassler*, and the *Blake*, have acquired a special reputation as deep-sea dredgers. The work of the *Bibb* and *Hassler* is known to naturalists mainly from the memoirs of Pourtales. Of the results of the *Blake* only a part has as yet been published under the direction of Mr. Alexander Agassiz.

Not only all naturalists but also hydrographers must be interested in the volume just published respecting the equipment of the *Blake*, a small steamer of only 350 tons burthen, which, under the skilful commands of Lieut.-Commander C. D. Sigsbee and Commander J. R. Bartlett, has not only done more rapid but also far more accurate work than has been accomplished with the old methods and appliances of the large men-of-war usually detailed for similar work by European governments.

Lieut.-Commander Sigsbee gives in this Report full descriptions of the thermometers, the water-cups, the salinometers, and of the methods of observing the currents in use on the *Blake*. The most important part of the Report is that devoted to deep-sea sounding. The sounding-machine, called a modification of Sir William Thomson's machine for sounding with wire, is known on the *Blake* as the "Sigsbee machine," and Sir William Thomson would find it difficult to recognise in the sounding machine of the *Blake* the apparatus he first suggested for sounding with piano wire. Throughout the Report the results of Lieut.-Commander Sigsbee's inventive genius are evident, from the water-cup to the shot detacher, the dredges, the trawls, the reels, the accumulator, there is nothing which he has not rendered more useful. His enthusiasm was shared by his officers, and their names

appear as his co-inventors on the Plates illustrating these different appliances.

The accuracy attained with Sigsbee's sounding-machine is very great, the probable error of sounding with piano wire at great depths not exceeding one quarter of one per cent. What the error may be if soundings taken by the old methods will only be known when all the former rope soundings have been repeated with wire soundings.

The last chapters are taken up with descriptions of the double trawls, the dredges, and other apparatus for collecting the animals found at great depths. An account is also given of making a haul at great depth and of the management of the steel wire rope, first introduced by Mr. Agassiz for deep-sea dredging on the *Blake*, and which has done so much to facilitate this class of work on vessels of the small tonnage of the *Blake*.

The Report is fully illustrated with heliotype plates as well as with tables showing the manner of recording the observations made.

It is pleasant to notice that the harmony between the civilians and the officers was not for an instant disturbed, during the three dredging cruises made by the *Blake*, extending from the Windward Isles to the Eastern extremity of George's Shoal.

The naturalists on board the *Blake* were indeed fortunate to have as their associates officers whose industry, energy, and interest in the work never flagged, and who have now attained a proficiency in deep-sea work hardly deemed possible three years ago.

OUR BOOK SHELF

i. *Elements of the Differential Calculus, with Examples and Applications: a Text-book.* By W. E. Byerly, Ph.D. (Boston: Ginn and Heath, 1879.)

ii. *An Elementary Treatise on the Differential Calculus, founded on the Method of Rates or Fluxions.* By John Minot Rice and W. Woolsey Johnson. Revised Edition. (New York: J. Wiley and Sons, 1879.)

NEARLY five years have passed since we noticed a small pamphlet by the authors of (ii.), together with treatises on the calculus of Messrs. Buckingham (Chicago) and Clark (Cincinnati), and we then remarked upon the growing interest taken in mathematics by American students. A further outcome of the same interest is the two works now before us. As it is not to be expected that such works will take the place in our colleges of the text-books already in use amongst English mathematicians, seeing that, like our own books, these are greatly indebted to the classic works by Duhanel and Bertrand, we shall not dwell at any length upon their merits or demerits. Each work under notice is well done to the extent to which it goes, and will furnish the young student with a good introduction to the admittedly difficult subject of which it treats.

(i.) takes as its foundation the "rigorous use of the doctrine of limits," introducing easy integration at a very early stage, and has frequent recourse to geometrical and mechanical illustration with a view to making the subject of interest.

(ii.) is the elaboration, in an excellent work, of the paper (subsequently a pamphlet) referred to above, which was introduced to the notice of English readers by a *résumé* of its contents in the *Messenger of Mathematics* (August, 1874) by Mr. Glaisher.

Both books are effectively got up, and (ii.) is exceedingly well printed.

Spirit-Gravities with Tables. By Thomas Stevenson, M.D., &c. (London: John Van Voorst, 1880.)

DR. STEVENSON has published a series of Tables in which the specific gravity of alcohol from 100 to 0·05 per cent. is given for each difference of 0·05 per cent. The percentages of alcohol by weight and volume, and of proof spirit are contained in the Tables. The specific gravities are given to four places of decimals. The Tables are founded on those of Gilpin and Drinkwater, and for spirits of less specific gravity than 0·8250—*i.e.* containing more than 89·05 per cent. by weight of alcohol—on that of Fownes.

In an introduction the various Tables hitherto in use are discussed; and various useful data are noted. The Tables are clearly printed, and will be of much service to those who are required to analyse alcoholic liquids.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

Supposed New Island in the Azores

A REPORT was current in the English and American newspapers some weeks ago that a new island had made its appearance among the Azores, similar in character to that which came up near the extreme western end of St. Michael's in the early part of the century. As I had determined to spend my long vacation among these islands, I was curious to witness a phenomenon so interesting and so rare as the birth of a new volcanic island. I learn that the report has its foundation in the occurrence of a landslip on the north-east end of St. George. A large portion (about 82 alqueiros in extent) of the land at Lapa, near the village marked Topo on Vidal's Chart, launched itself bodily into the sea—that is, in an almost unbroken mass, to a distance of about 300 metres from the mainland. There were a number of cattle grazing on the land at the time; these apparently were so little affected by the occurrence that when found they were feeding unconcernedly on "the new island," as if it had been associated with their whole existence. A little survey of the spot has been made, and the Director of the Public Works at Vellas, the chief town of St. George, was kind enough to give me a map of this, the most recent addition to—or perhaps one ought to say subtraction from—the Azores.

T. E. THORPE

Parthenogenesis in the Coleoptera

IN the "concluding remarks" in his treatise on "Wahre Parthenogenesis" (1856), von Siebold says, "Es ist daher jetzt Aufgabe der Entomologen, nach weiteren Beispielen von Parthenogenesis in der Insektenwelt zu forschen"; and on the last page (237) of his "Beiträge zur Parthenogenesis," published fifteen years later, he expresses the conviction that many facts relating to this phenomenon are still to be discovered. The instances of *true* parthenogenesis discussed or referred to in these two works relate to insects of the orders Hymenoptera and Lepidoptera, and to some crustaceans. Including viviparous agamogenesis, however, as parthenogenetic, the orders Hemiptera and Diptera also furnish examples of this mode of reproduction; and for its occurrence in at least one genus of the Trichoptera I have the authority of Mr. R. McLachlan, F.R.S. The possibility of parthenogenetic reproduction in the Coleoptera rests only, so far as I am aware—see "Comparative Embryology," by F. M. Balfour, vol. i. p. 64—on the single instance communicated by me to this journal last year (Nature, vol. xx. p. 430), and this being so, it seemed desirable to make sure of this point by further research during the season now almost past. Accordingly I have this year kept a considerable number of females of *Gastrophysa raphani*, laying unimpregnated eggs, and with results which have not only confirmed the previous experience, but much extended it, as I am at present in possession of a living

beetle reared from a parthenogenetic ovum. With your permission I shall now endeavour as briefly as possible to give those circumstantial details without which a bald statement of results would not carry with it a rational conviction of the accuracy of my observations.

From beetles gathered in the beginning of last April I had a batch of eggs on the 7th, which hatched out on the 21st of the same month, and on May 13–15 yielded about thirty pupæ, which were immediately put into separate vessels. On the 20th–22nd appeared the imagines, of which ten subsequently turned out to be females, and were placed together in pots, but not before the greatly enlarged abdomen had given unmistakable evidence of their sex. The first eggs, three batches, were laid on June 2 (so completing the cycle, from egg to egg, in fifty-six days). On the 12th of the month I found in one of these batches, consisting of forty-two eggs, thirteen developed, of which two hatched out, the larvæ dying shortly afterwards. Others seemed to have partly hatched, but most eventually perished in the shell. At this time fertilised eggs were hatching in nine days. It appeared to me that several of the thirteen were imperfectly or monstrously developed; one, for example, having only one misshapen (?) mandible; another, excess in number and irregularity in grouping of the eye-spots; &c., &c. Again, on June 17 I found in a parcel of (twenty-five) eggs, laid June 6-7, six which had developed up to the hatching. In the usual course, at the time of hatching, the young larva comes out of the shell clear like barley-sugar, but blackens afterwards; in the case of these parthenogenetic larvæ which do not hatch out, this blackening takes place within the shell. In a third batch, of over twenty eggs, laid June 8, I found three eggs similarly developed. In the meantime, and afterwards, many dozen batches had been laid, in which, however, I did not detect any development.

A second experiment miscarried; but I was more successful with a third and fourth. From a batch of eggs laid June 5–6 I derived pupæ which on July 8 following I placed separately in pots, and obtained from them thirteen beetles, of which seven turned out to be females. About the same time I brought in from the fields some well-grown larvæ, the beetles from which were isolated immediately after their exclusion, and subsequently yielded eight females. These (seven and eight) were all kept in separate pots during the course of the experiment. Of the seven no less than five laid eggs which afterwards developed parthenogenetically. They laid as many as ten parthenogenetic batches among them, but while some of them laid three such batches, others laid only one. These were invariably the first batches laid, and none of the batches laid subsequently contained any viable eggs while the experiment lasted, which was in some cases up to the tenth batch. Of the eight beetles of the fourth group, only one laid one parthenogenetic egg in its first batch. The number of parthenogenetic eggs in a batch varied from one to seven. In four batches there was only one such egg; in three batches five, and in the other four batches two, three, six, and seven respectively. The total eggs in a batch averaged 41·7, and as there were thirty-six parthenogenetic, the proportion over all was 1 in 12½. However, as may be supposed, the proportion in the individual batches varied very much, one small parcel of only eleven eggs having as many as five developed.

In most of these cases also the larvæ perished in the shell. A few hatched out more or less completely, and died. Two, however (of the seven in one batch), were more fortunate. These came out on July 29, and for some hours seemed very feeble and barely alive. Next morning I found that one, which subsequently took the lead of its fellow in all respects, had crawled away under cover, and the other was soon able to follow its example. I could not find that they had eaten anything till the evening of the 31st. After that, however, they throve apace. The larger one passed its first and second moults on the 3rd and 7th of August, the smaller following it on the 4th and 8th. The former pupated on the 14th, and the imago was excluded on the 19th. The latter, having pupated, August 15–16, appeared to go on well till the time for the exclusion of the beetle, when its further development became arrested, and it died. The survivor was weakly at first, and rather imperfect always as regards the elytra, which are somewhat small, and do not close in the middle line. It has, however, thriven well, and developed that enlargement of the abdomen peculiar to the female. But up to the present (September 22) it has laid no eggs, nor shown any inclination towards males placed in the pot with it.

When it became obvious that no more parthenogenetic eggs were to be obtained from these beetles, I placed the survivors of them in succession in a pot with a (the same) male beetle, with the result that most afterwards laid fruitful eggs in the ordinary way. I mention this because it seems to be in contradiction, as far as these insects are concerned, with the statement of von Siebold ("Beiträge," p. 89): "Es ist nun eine bekannte Sache, dass, wenn Insecten-Weibchen vor der Begattung erst einmal Eier zu legen angefangen haben, ihre Männchen alsdann mit ihren verspäteten Liebesbezeigungen bei ihnen nichts mehr auszurichten im Stande sind."

If now I may be permitted to make a few general observations on some of the points indicated for further inquiry, rather than established, by the foregoing experiments, I would say: (1) that parthenogenesis seems to occur chiefly in the first-laid batches; (2) that it is peculiar to some females, while others appear to be exempt from it; (3) that confinement and domestication, as it were, acting hereditarily, which we already know so profoundly to affect the generative system in the higher animals, appear to favour this mode of reproduction in *Gastrophysa raphani;* (4) that there are degrees of viability in parthenogenetic embryos, so that the development seems to be arrested chiefly at certain points, as at the hatching of the egg and the exclusion of the imago. In this respect the Gastrophysa egg behaves very much as the ovum of *Bombyx mori* is reported to do (*v.* "Beiträge," pp. 230–232). (5) Another point in which *G. raphani* agrees with other parthenogetically reproductive arthropods is its many-broodedness in a season. There may be three or four generations in direct succession in the year, and there is a constant succession of eggs all the time. In this it appears to differ from any of its allies with which I am acquainted. (6) Finally, the case of *G. raphani* would seem to be one of true parthenogenesis in its most restricted sense—the same beetle which in the unimpregnated state lays sterile eggs, with here and there one capable of development, after receiving the male element, laying eggs which are fertile and develop in the ordinary way. That is to say, the ova are true ova, and not pseud-ova or buds, the parent a perfect female and not an "Amme" like the summer Aphis.

J. A. OSBORNE

Milford, Letterkenny, Ireland, September 22

Observations of Auroræ on August 12 and 13

THE finest display was between 10 and 11 o'clock on the evening of the 12th, when a magnificent corona was formed almost exactly on γ Cygni. At this time the bases of the columns on the eastern horizon were distinctly red. Unfortunately the spectroscope could not be brought to bear until the aurora had faded to a small fraction of its greatest brightness. With a very small dispersion (Vogel spectroscope) the spectrum was continuous from W.L. 557 mm. to W.L. 473, with strong traces of a finely banded spectrum, terminating abruptly at the great line 557. Towards the violet an isolated line was seen and measured.

On the 13th the great line was seen and also traces of the others. The measures may be summarised as follows:—

Wave-length.	Spectroscope.	No. of measures.
557·16 ± 0·20	Grubb	8
527·5	,,	1
469·6	,,	1
473·2	Vogel	1
430	Grubb	In middle of field
434	Vogel	1

The Grubb spectroscope has a dispersion of 5° 40′ from C to *h*. The first line was measured with an illuminated micrometer wire, the others with the edge of an opaque screen. The Vogel spectroscope has a scale of bright lines with sixty divisions to the whole visible spectrum.

RALPH COPELAND

Lord Lindsay's Observatory, Dunecht

Ice at High Temperatures

FROM Mr. Hannay's letter (NATURE, vol. xxii. p. 483) and from private communications I have received it appears there has been a little misconception as to the manner in which I judged of the temperature of the ice in the experiment referred to in NATURE, *ibid.*, 435. Mr. Hannay's theory, that the ice was protected from the hot glass by an intervening layer of vapour, at first occurred to myself and to others as the true explanation of the phenomenon, but that this explanation will not serve in the present case is, I think, proved by the fact that a thermometer *was* imbedded in the ice and rose to temperatures varying in different experiments between 120° and 180° C., at

which points the ice had either all volatilised or had become detached from the bulb. This appears improbable from our present ideas concerning latent heat, but it is nevertheless a fact. If I can make the necessary arrangements it is my intention to show the experiment at an early meeting of the Chemical Society, when it will be open to criticism.

In regard to the remarks contained in the former part of Mr. Hannay's letter, I of course did not bring forward the *first* proposition in my letter as anything new, but merely to show that my experiments confirmed the previous conclusions of others on the critical temperature. THOS. CARNELLEY

Firth College, Sheffield, September 27

A Peat Bed in the Drift of Oldham

IN NATURE, vol. xxii. p. 460, there is a description of a bed, or rather beds, of peat in the drift at Oldham. A few days ago I had an opportunity of examining the section described by Mr. Jas. Nield, and under his guidance, but I differ from him in opinion as to the age of the peat. The section occurs on the steep sloping side of a valley, and just above it there is an exposure of sand covered by boulder clay. In my opinion some of the latter has simply slipped down, off the sand, on to the surface of the peat at a lower level; or it may have been excavated and thrown down for the purpose of obtaining the underlying sand. Besides, the principal bed of peat rests on blue silt, which again rests on boulder clay. The upper bed of peat occurs at one end of the section, and both ends present the appearance of a talus of *débris* from a higher level. Still the section is somewhat obscure, though a few hours' digging at a right-angle to its present exposure would probably prove the blue silt and peat to be more recent than the boulder clay, although the latter is certainly the highest bed in the section as at present exposed. However, geologists are indebted to Mr. Nield for calling attention to the section, and no doubt he and others will take means to prove the true position of the peat, which is sure to attract considerable attention.

G. H. MORTON

122, London Road, Liverpool, September 18

Hardening of Steel

I SHOULD have, had circumstances permitted, thanked Mr. Walter R. Brown for his kind response to my letter, "Iron and Hydrogen" (NATURE, vol. xxii. p. 220), and for the reference to Mr. Anderson's report, with which I was unacquainted.

The points mentioned by Mr. T. W. Giltay certainly seem somewhat to controvert the theory of alloyed hydrogen; but thinking over the facts some time ago it struck me that the aqueous vapour in the air would be a source for the gas as in chilling beneath water. It would be interesting to know whether mercury, as commonly used, is not also faintly alloyed with hydrogen.

For my own part, I am inclined to the carbon theory, but the facts were brought forward with the idea of seeing them discussed, and a somewhat obscure but important subject brought to light. H. J. JOHNSTON-LAVIS

Mosquitos

SEEING in NATURE, vol. xxii. p. 11, the use of infusion of quassia recommended, and being a great martyr to mosquitos, I immediately set to work to brew two or three gallons with all the energy with which I had already tried many remedies and nostrums.

The basements of nearly all the good houses here in Naples are used as stables, and consequently form a great attraction for these insect pests.

This large quantity of very concentrated infusion was disposed of as follows:—The whole of the bed-room walls, ceiling, carpet, and furniture were gone over with a Lister's vapour carboliser containing the solution; sheets and night-dresses wrung out and dried before use, body sponged all over, and bed clothes re-sprayed with the solution each night.

This certainly was a fair trial, but the results after all this expense, trouble, bitter lips and mouth was a complete failure.

It really seems that the only true protection against mosquitos is the curtain with all its inconveniences.

September 21 H. J. JOHNSTON-LAVIS

GENERAL PITT RIVERS' (LANE FOX) ANTHROPOLOGICAL COLLECTION[1]

II.

OUTRIGGERS are very varied in their structure. In some canoes there are two opposite one another, one of which does not touch the water; it is merely a balance platform; in some both outriggers only occasionally touch the water. It is not improbable that the side-galleries of some junks are developed out of balance platforms, and that the ledges known as the "chains" of modern European vessels are of similar origin. The rudder is merely a development of the steering paddle. It is still merely a fixed paddle, being worked by an operator with his face in the direction in which the boat is moving, whilst oars have taken the place of all the other paddles of the boat.

Another series illustrates the origin of clothing. Clothing was derived, no doubt, partly from the development of ornaments, being originally entirely ornamental, as a large proportion of it still is, even amongst ourselves, and partly from gradual modifications of belts and such accoutrements, which served a useful purpose when put round the body as convenient appliances for hanging things to for carriage. A pocket is a luxury which a savage does not possess. He has to sling his little necessaries to his belt, or secure them in the lobe of his ear, or carry them, to his embarrassment, in his hand. Even in Japan the men are obliged to sling their tobacco-pouches and pipes from their belts by means of silken cords and the beautifully-carved ivory buttons or netsukes so well known in European collections. They have pockets only in their sleeves, and these are insufficient. The simple cincture is the sole clothing of the Andaman Islander. A bunch of pandanus slips is added in front in a further stage, and eventually a complete encircling fringe is reached. When paper cloth (tappa) has been invented, or woven material, this is substituted for the fringe, and a kilt is the result. In some parts of Great Britain dress has not advanced beyond this stage, or rather the primitive form of dress has been adopted as a curiosity. The sporran probably represents the original dress, the bunch of grass of the Andaman Islander, now worn over the kilt instead of as originally next the skin. At a further stage, the kilt being found uncomfortable, it was fastened together at one spot between the legs, and hence arose the idea of trousers, which, through the baggy Turkish inexpressibles, gradually developed into their present form.

The simple cloak of skin or tappa developed gradually into coats and various more convenient tight-fitting garments, but in all robes of ceremony the savage cloak form is still retained by the most highly civilised races. One of the latest additions made to his collection by General Pitt Rivers is a series of Britanny caps, showing the gradual development of all the strange forms in vogue in different districts, by means of the abnormal growth of the strings, crown, or front, of one simple type.

Another series shows the development of drinking-vessels of all kinds, starting from the natural vessels found ready to hand, such as human skulls, cocoanut-shells, gourds, and horns. From the cocoanut with a handle comes the ladle, and hence the spoon, and so on.

Another series is devoted to the development of musical instruments. Wind instruments are modifications derived from the horns of animals, spiral shells, reeds, bamboos, and bones. From these by gradual steps are attained the trumpet and spiral brass instruments, the curl of which probably came from the spiral shell; also pan-pipes, and hence organs, and flutes. As bearing on the origin of the bagpipes is exhibited a bag and whistle carried by Indians of the north-west coast of America to imitate the call of ducks and decoy them.

[1] Continued from p. 493.

Drums were derived from bamboos, being at first simple pieces of bamboo open at both ends and beat on the ground as now at Fiji. Wooden logs are then hollowed out to imitate them, and hence the large erect wooden drums of New Guinea and Melanesia generally, and the horizontal canoe-like drums, "lali," of Fiji. But these hollow wooden drums without a tense membrane are more justly classed with bells, and metal bells were probably derived from them through the wooden bells such as those used in Japan. The clapper is a late addition to the bell, which does not exist in Japan or China. It is worthy of note that the large wooden drums of Fiji and Papua are used for the same purpose as bells, to summon large meetings and communicate general warnings or similar intelligence. Dr. Michlucho Maclay has given a full account of their use in New Guinea.

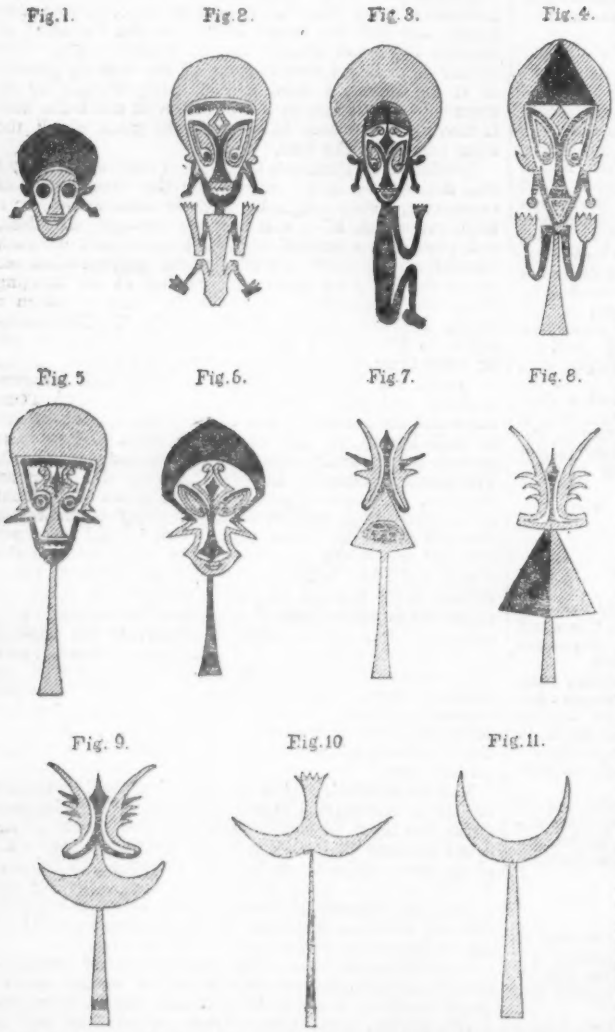


PLATE 3.—Ornamentations copied from a series of canoe paddles from New Ireland, showing the gradual degeneration of the representation of the human form into a crescent-shaped ornament.

A tense membrane having been added to one end of a bamboo, the real drum was reached, and from this is derived the Papuan drum, which is long and pipe-like in form, and has a membrane of lizard skin (Hydrosaurus) at one end. It is often shaped like a crocodile's head at the open end, is somewhat dice-box-shaped, and is used in dancing.

Another series is devoted to the growth of the art of pottery. Amongst savages the Fijians are pre-eminent for the excellence of their pottery and for the variety and grace of the forms of the vessels which they manufacture. The common simpler flask-shaped form made by them is said to have been suggested by that of the nest of a wasp (*Polistes*, sp.) common in the islands. They glaze their pottery, and make vessels in the shapes of animals such as turtles, in all kinds of forms, even in double and triple clusters, recalling to mind the pottery of ancient Peru.

Yet another series exhibits the extent to which various races of mankind have succeeded in representing the human figure in wood, stone, or ivory carving, or models, or in pottery. It is interesting to trace here the steps by which the art of sculpture has grown. Sculpture grew by the most gradual steps to its civilised excellence. When savages produce the excessively rude representations of men which commonly do duty as gods, the faults in the work are not due to an absence of power to execute better carvings, but simply to an absence of accumulated experience as to how the human figure should be represented. It is remarkable how extremely well some savages copy European carvings when once they get the chance of a little teaching. As an example of this sort of work General Pitt Rivers displays a carving of the Virgin and Child executed by the Qua Qua Indians of the North-west American coast. The piece might pass muster as an example of modern Swiss work. Besides this specimen are three sitting figures in the old unassisted native style, carved by the Vancouver Islanders. They are very different indeed in execution, and rude, but they still show a certain amount of artistic feeling. Indeed, the whole of the Indians of the Upper North-West Pacific coast, and especially the Haidahs, are conspicuous for very advanced artistic powers as savages. Savages vary immensely in their artistic development. Many, such as the Hottentots and South African races generally, appear never to have made any representations of the human figure. Those who do make such figures always adopt a conventional form for them, which is so well marked that an experienced eye can detect at once by what race any particular figure has been made. Perhaps the most curious figures are those of Easter Island, with shrunken abdomens and prominent ribs. The figures seem copied from half dried-up corpses, and were perhaps copied from the dead originally. Some Peruvian human faces are extremely good; but the Japanese and Chinese seem never to have idealised the human countenance, except perhaps in their representations of Buddhist gods, the faces of which are however more or less Indian in type, so that the idea was probably derived, with the religion, from extraneous sources.

A considerable series is devoted to the development of religious properties of various kinds from different parts of

the world. Side by side are placed the coarse wax models of breasts, hands, feet, eyes, and other parts of the human body offered up at the present time in Roman Catholic shrines in France and elsewhere by persons who have been cured of diseases in those parts, and the exactly similar earthenware models of the same parts which were used for the same purpose in ancient Cyprus, and have been found there in excavations. It is most curious how exactly the two series correspond. A small collection comprehends the representations of the Mother and Child of various races. Side by side may be seen and compared the Peruvian, Cyprian, Egyptian, Indian, Chinese, and Christian embodiments of this idea.

Several series are devoted to the curious question of the development of pattern ornament. The development of patterns appears to have arisen in two ways: either drawings of various natural objects have been made upon weapons, implements, and utensils, and these drawings, having become more and more conventionalised by successive copyings, have degenerated into patterns which have in many instances been subsequently elaborated as such; or various patterns have been from the first suggested by various articles often used in connection with the objects ornamented, by coils of string, or by wire, or by nets, or accidental markings on the objects themselves. Patterns thus once commenced have been gradually modified, and have run through a series of changes which can be traced step by step. A particular elaborate pattern is a thing which has probably arisen only once in the progress of evolution, and in tracing its history we trace at the same time the history of the race which makes use of it. It may yield as important evidence as even language itself.

The earliest known ornamentations are those of primitive man found in the caves of Europe. They are all representations of animals, figures of the mammoth, cave-bear, or reindeer scratched on ivory or bone. Some of the most interesting of General Pitt Rivers' series are those which show how such rude figures gradually de-

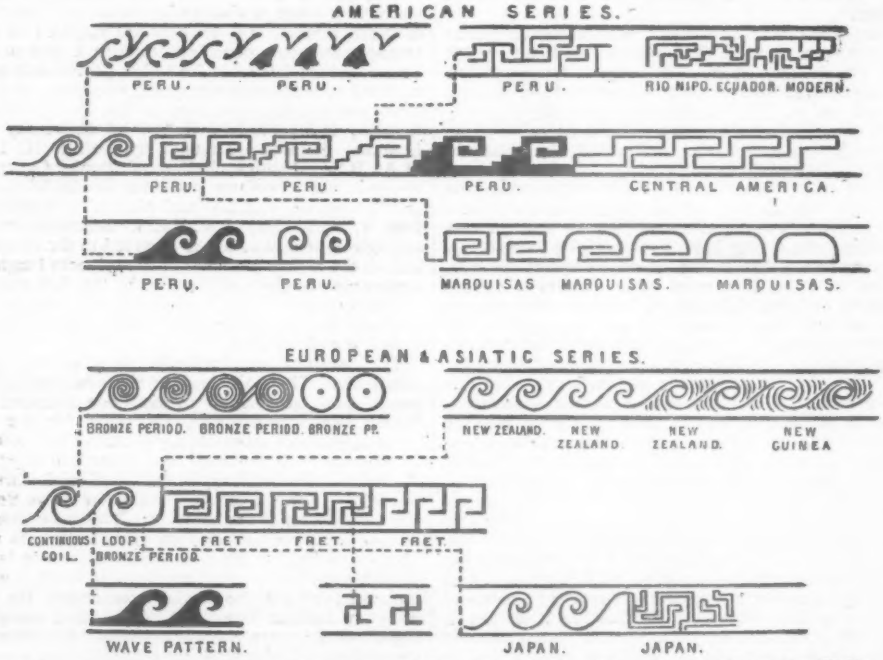


PLATE 4.—Series of diagrams to illustrate the various modifications of the double loop coil ornament in the Old and New Worlds.

generate into mere conventional pattern ornaments. One of the most striking examples is one described by him in his address to the Department of Anthropology at the meeting of the British Association at Brighton in 1872. It is the series of transformations which are undergone by a figure of a human head represented on their paddles by the natives of New Ireland. The series is shown in the annexed woodcut (Plate 3), taken from the specimens exhibited in the collection. The human figure gradually loses its limbs and body, then the sides of the face, leaving only the nose and ears, and ultimately the nose only, which finally expands at the base, and is converted into the representation of a half moon. In this sequence we have an exact parallel to the transformations observed upon ancient British coins by Mr. John Evans, by which the representation of the chariot and horses of Victory on a coin of Philip of Macedon becomes converted into a single horse, and ultimately into fragments of a horse.

Amongst the natives of the North-West coast of America a curious intricate conventional ornament represented on all their paddles and many other objects, is derived from an albatross head, as shown in a series in the collection. A series of curved wooden sharp-edged clubs or glaives show how the form of a fish, to represent which the curved head of the club is carved, degenerates into a single W ornament, the remains of the fish's mouth. Mr. Brooke Low has in his Bornean collection already referred to a series of native fabrics ornamented with elaborate patterns, each of which pattern has a name, usually the name of an animal. One pattern is evidently a representation of a crocodile, it is so named, and others are derived from it. He finds it impossible to determine in many instances by examination from what form the other patterns have been derived, but believes that the history of their origin survives in their names. One name given to them was, for example, "cat," referring to the animal, from a drawing of which the pattern was originally developed. No doubt all the curious patterns in vogue

in Polynesia, New Guinea, and elsewhere, have a definite history and meaning yet to be traced. Modern European patterns have also interesting histories to disclose. One of the series in the collection explains the origin of the lozenge- and leaf-pattern common on oak carvings from the intersections of the Gothic arch and ogee arch.

Of the development of ornament from chance marks upon objects, the most interesting example exhibited is probably an Australian boomerang, which happens to have three small round black knots on one side of it placed at equal intervals. The savage owner, struck by the appearance of the knots, burnt a series of similar black marks at equal distances all along the one face of the boomerang, to complete the natural pattern, and then, pleased with his work, put a series of lozenge-shaped marks to correspond on the other side of the weapon. At the Sandwich Islands a most beautiful ornament of the gourds used for water is derived from the net-bag in which the gourds were slung. No doubt the pattern at first became accidentally printed on the gourds, and were afterwards elaborated.

The last series to which we shall draw attention relates to the transformations of the curious ornament which General Pitt Rivers calls the double-loop coil, and which is characteristic of all New Zealand weapons and implements, canoes and houses. The ornament was probably originally copied from coils of string or wire. The distribution of the ornament is very interesting. It is found abundantly in New Guinea, so exactly corresponding to the New Zealand form that it seems certainly to point to some connection between the islanders or partial migration from New Guinea to New Zealand at some time or other, unless some floating object may have conveyed the pattern. A similar ornament occurs in the far-off Marquesas Islands, the natives of which in several other matters of culture show affinity with the Melanesians. It is also very common on Mexican and Peruvian works of art, and especially on gold figures, where it is represented in its former live form by spiral coils of fine wire. From the double-loop coil, as General Pitt Rivers has shown, many other patterns are derived. The fret or key pattern is merely a continuous loop-coil squared. Other patterns, such as the wave pattern, are derived from the coil by slight degeneration. Some of the most marked patterns derived from it are shown in the accompanying figure (Plate 4), which explains itself. It is most curious how nearly parallel the series of modifications attained in the Old and the New World run to one another.

In conclusion we can only express a hope that the Pitt Rivers collection will be accepted by the nation on its generous donor's conditions, and we strongly recommend any of our readers who have not studied it to pay it a long visit at once, and profit by the varied fund of instruction and entertainment which it cannot fail to impart.

THE MASON COLLEGE, BIRMINGHAM

THE Josiah Mason Science College, which is to be opened by an interesting address from Prof. Huxley to-morrow, was begun about five years ago by the venerable and generous donor, Sir Josiah Mason. It is intended to cover ground not occupied by any other of the numerous educational institutions of Birmingham, to which it promises to be an addition of the highest value. The building itself is described as a lofty and spacious Gothic pile, covering about an acre in extent in the very heart of Birmingham.

By its foundation deed the College is established to provide instruction, as far as possible, in mathematics, abstract and applied; physics, both mathematical and experimental; chemistry, theoretical, practical, and applied; the natural sciences, especially geology and mineralogy, with their application to mines and metallurgy; botany and zoology, with special application to manufactures; physiology, with special reference to the laws of health; the English, French, and German languages; and the scheme may, in the discretion of the trustees, include all such other branches of instruction as will conduce to a sound practical knowledge of scientific subjects, excluding mere literary education. The trustees have also power to make provision for instruction in art as well as in science; and, by a supplemental deed, they are authorised to include in the course of study certain subjects requisite for the training of medical students. There is no restriction of the advantages of the college as to sex, creed, or birthplace; but, other things being equal, preference is to be given to candidates who have been educated in Sir Josiah Mason's Orphanage at Erdington, and after these to persons born in Birmingham or Kidderminster, the latter being the founder's birthplace. One wise provision of the deed empowers the trustees, with certain reservations, to alter the course of teaching and the arrangements of the instruction when a change is considered desirable, and at stated intervals the trustees are required to take the arrangements into consideration with a view to revision. At present the branches for which provision is made are confined to mathematics, physics, chemistry, and biology. The mathematical professor is Mr. J. M. Hill, M.A., London, B.A., Cantab, Fellow of University College, London. Physics are taught by Prof. J. H. Poynting, M.A., B.Sc., London, Fellow of Trinity College, Cambridge. The chemistry professor is Mr. W. A. Tilden, D.Sc., London, F.R.S.; and biology is represented by Prof. T. W. Bridge, M.A., F.Z.S. According to present arrangements instruction is provided in the elementary as well as the higher branches of the sciences taught, with a special view to their application to the industries of the Midland district. The course is also designed to prepare students for the degrees of B.Sc. and D.Sc. in the University of London.

The internal arrangements seem to be altogether admirable. The main corridor abuts on two noble apartments, each 48 feet by 30 feet—one intended for the library and reading-room, the other for the physical laboratory—both rooms being provided with ante-rooms. On the first floor, the chief and central room, situated in the front of the building, is the chemical lecture theatre, 50 feet by 33 feet, fitted with seats, tier above tier, for the accommodation of 155 students. The male students will occupy the lower half and the female students the seats above and behind them, a separate entrance being provided for each sex. The mechanical arrangements and apparatus for the use of the lecturer and the carrying away of noxious fumes are of the most complete and ingenious character, and the assistants' ante-room, for the preparation of chemical experiments, is on an equally satisfactory scale. Class-rooms for electricity, magnetism, biology, physics, and models, and a couple of spacious lecture theatres, each 47 feet by 30 feet, one for biology and mathematics, the other for physics, occupy the remaining space on the first floor. The second floor is devoted principally to the chemical departments, for which the arrangements are of the most complete and elaborate character. A large room, 52 feet by 33 feet, in the front of the building, over the chemical lecture theatre, will be used as a general assembly or examination room, and will be available for the meetings of scientific societies. The two laboratories situated at the back of the building, and lit both by windows and skylights, measure together about 104 feet long by 32 feet wide. In the larger laboratory, intended for qualitative analysis, there are four double operating-tables fitted with sinks, gas and water for forty students, in addition to a large unencumbered table in the middle of the apartment for long trains of chemical apparatus. The laboratory for quantitative analysis contains similar fittings and appliances

for thirty-two students. On the third floor a large and lofty central room, with open limber roof, partially lit from the roof, is intended for a museum. The basement story, extending under the whole of the ground floor, is lofty and well lighted, and contains store-rooms, rooms for special operations in physics and chemistry, a large room for mineralogy, rooms for living animals, boilers, &c. Altogether the building contains at present about 100 rooms. The heating and ventilating arrangements are upon a somewhat novel plan. Near the centre of the area rises a huge chimney-stack to the height of 160 feet, containing three flues divided by thin partitions. The smoke from the boiler passes off by the central flue and heats the air in the adjoining flues, which are used for ventilating the lecture theatres. The warming is effected by a coil of pipes containing 4,475 superficial feet, and fed with water from the large boiler in a vault in the sub-basement. The arrangements in fact are throughout of the most modern and approved types, having been adopted by the architect after mature consideration of all the best features of the principal scientific colleges in this country and on the Continent, which he visited at the request of the trustees.

The generous founder, who has taken a most active interest in the progress of the work, has built the college and furnished its various departments entirely at his own cost, so that the large endowments previously conveyed to the trustees remain untouched. Sir Josiah Mason has stated that his ambition was to afford all classes in the Midland district, where he had been born and bred, the means of carrying on those scientific studies of which he had felt the want as completely and thoroughly as they can be prosecuted in any of the great science schools of Europe.

We earnestly trust that the noble and benevolent intention of the founder will continue to be carried out, and that in time the institution will become as important and comprehensive a centre of higher education as Owens College is now.

THE PROPOSED LICK OBSERVATORY

MR. S. W. BURNHAM has printed his Report to the Trustees of the "James Lick Trust" of observations made on Mount Hamilton, California, with reference to the location of the observatory, for the erection and endowment of which funds are thereby provided. His object being to test the adaptation of the site for astronomical purposes by observations of double-stars mainly, Mr. Burnham took with him his 6-inch refractor, by Alvan Clark and Sons, which he has used in nearly all his astronomical work, and the excellence of which has been sufficiently proved by the number of difficult double-stars discovered with it during the last six or eight years. He remained on Mount Hamilton from August 17 to October 16, and in this interval was in the observatory on every clear night, with three exceptions. During the first thirty-seven nights he states vision was first-class on all occasions with these exceptions; on two nights the ocean fogs from the valley below reached the summit of the mountain and remained all night, and on two other nights there was only medium steadiness. The kind of weather for astronomical observations during the whole period of sixty days that Mr. Burnham remained at the summit, was forty-two first-class nights, seven medium nights, and eleven cloudy and foggy ones. In the whole interval there was not a single poor night when it was clear. By first-class seeing Mr. Burnham explains that he means "such a night as will allow of the use of the highest powers to advantage, giving sharp, well-defined images, and where the closest and most difficult double-stars within the grasp of the instrument can be satisfactorily measured." The conditions were generally very permanent for the whole night, which is not often the case in ordinary localities. On many nights Mr. Burnham remained at the telescope until daylight, and so had abundant opportunities of noting this important fact.

Having provided himself with a series of cardboard disks, with apertures increasing from one inch up to the full aperture of the object-glass, Mr. Burnham observed a large number of familiar objects, contracting the light until the smaller star was just distinctly visible; many of these objects had been used elsewhere for a similar purpose. He considers some of the observations are remarkable, allowing for the difficulty of the objects with much larger apertures in other localities: μ^2 Herculis (the close pair) was very fairly seen with the full aperture, and the companion of α^2 Capricorni was plain with the aperture contracted to 4 inches, and was seen double with the whole six; these objects Mr. Burnham says he is confident have "never been seen before with so small an object-glass." The fifth and sixth stars of θ^1 Orionis were very plain at an hour-angle of 4½ hours; ζ Herculis was well seen with 3½ in.; and η Cassiopeæ was easy when the aperture was reduced to 1½ inch. Forty-two new double stars were detected, and micrometrical measures of ninety of these objects previously named were put upon record. A great many were examined by daylight, but the air, during the greater part of the day at least, was not found to be steadier than is ordinarily the case elsewhere. It is mentioned, however, that the fifth and sixth stars of the trapezium of Orion were beautifully seen in broad daylight just before sunrise. At the epoch 1879·684 the first measure was made fifteen minutes before sunrise, and "both stars were readily seen for some time after this." Venus was very readily seen with the naked eye at any hour of the day, and easily found without any instrumental indication of its place. Mr. Burnham urges that the new double stars brought to light evidence better than anything else can, what may be done at Mount Hamilton, and remarking that these discoveries were effected with an instrument which in these days of great refractors would be regarded as a comparatively inferior telescope, he considers that it is impossible to overestimate the great discoveries which might be made at this station with a first-class object-glass, such for instance as the Naval Observatory, Washington, already possesses, or the proposed Pulkowa glass of twenty-five times the light-power of the one employed; and according to the terms of the Trust the telescope for Mount Hamilton is required to be "superior to and more powerful than any telescope ever yet made;" a condition, however, which perhaps may not be so easily fulfilled as laid down. Mr. Burnham concludes from his experiences on Mount Hamilton that it "offers advantages superior to those found at any point where a permanent observatory has been established." The station is about fifty miles south of San Francisco and twenty-six miles nearly east of San José, the nearest point of railway connection. The ocean fogs, which might have been feared, were not found to reach the elevation, except rarely. Nearly every night this fog, commencing soon after sunset, comes in from the Pacific between the Golden Gate on the north and the Bay of Monterey on the south, and covers the whole valley, but is ordinarily perhaps 2,000 feet below the summit of the mountain, which has an elevation of 4,250 feet above the level of the sea, and has no sensible effect at such altitude.

It will be seen that Mr. Burnham's knowledge of the locality is confined to the space of two months, but a letter from Prof. Davidson of the U.S. Coast Survey, who has had long experience at other seasons, is appended to the report, which is of a very favourable nature, and Mr. Burnham appears to have no hesitation in advising the adoption of Mount Hamilton as the site of the Lick Observatory, which we may hope will be successful in procuring an instrument worthy of the other great astronomical

advantages which it is likely to possess. The geographical position of the observatory peak is in longitude 121° 36′ 40″ W., latitude 37° 21′ 3″ N.

THE UNITED STATES WEATHER MAPS FOR OCTOBER AND NOVEMBER 1878

THE WEATHER MAP for OCTOBER 1878, which appeared in our issue of August 19, showed an area of barometric depression overspreading the whole of the United States except a narrow patch extending from Great Salt Lake northwards. The depression was deepest in the region of Minnesota, where it was 0·150 inch under the average, stretching thence in a west-south-west direction toward San Diego, where it was 0·077 inch below the mean. On the Atlantic sea-board of the States, pressure was 0·014 inch in the south and 0·033 inch in the north below the average, and continued relatively low right across the Atlantic, the depression deepening to another minimum over the region including the north-west of Ireland and Scotland, where the greatest defect from the average reached 0·220 inch. This wide-spread depression stretched still further to eastward over the whole of Europe, except the extreme north of Scandinavia, the southern half of Italy, and all Russia, except its north-western provinces; and to southward at least as far as the equator. Another extensive region of low pressure covered the whole of Asia to the south of a line drawn from Shanghai round by Lake Balkash to the Persian Gulf, and extended south-eastward over the whole of the East India Islands and Australasia as far as the east coast of New Zealand, where atmospheric pressure rose to the average of the month. Pressure was also much under the average in Cape Colony and Mauritius.

On the other hand pressure was above the average over the head waters of the Platte and Missouri rivers, and from Vancouver Island northward over the north-west of America, rising to an excess of 0·180 inch in Alaska. But the most important area of high pressure covered Greenland, where it rose in the south to 0·244 inch above the mean, and spread to the south-westward over Labrador, Newfoundland, and the Dominion of Canada as far as Montreal, and to the eastward over Iceland and the north of Scandinavia. A third area of extensive high pressure embraced the southern half of Italy, Greece, Egypt, Syria, nearly the whole of European Russia, and all Asia to the north of the area of low pressure already pointed out.

The distribution of the temperature anomalies of the month were of the simplest character in their relations to this anomalous distribution of the pressure. In the States to westward of the line of greatest barometric depression a reference to the map will show an extraordinary prevalence of strong north-west winds, where, consequently, temperatures were low, the defect from the average being 4°·8 at Winnipeg, 4°·0 on the Platte, 3°·6 on the Lower Columbia, and 2°·6 at San Diego. On the other hand, temperatures were everywhere above the average to the east of the Mississippi, the excess being nearly 5°·0 in the New England States, but only about the third of a degree in Florida in the south, and in Newfoundland in the north.

Turning now to the great depression north-west of the British Islands, winds were northerly in Iceland and South Greenland, and there the temperature was respectively 2°·3 and 1°·1 below the average. Pressure rose higher from west to east over Europe as far as the Ural River, and into Asia as far as the Tobol, where it was fully 0·100 inch above the mean pressure of October. Westerly and southerly winds accordingly ruled, and temperatures were everywhere above the average over this large tract of the earth's surface, the greatest excess being in the basin of the Dnieper, the maximum 7°·6 being recorded at Kiev. Pressure was 0·012 inch in excess of the average in Syria and Egypt, but the northerly winds in Syria indicate a lower pressure southward, and in accordance therewith temperature was 2°·0 at Beyrout and 0°·7 at Alexandria below the mean. From the rivers Ural and Tobol eastward through Siberia to the Sea of Okhotsk, temperatures were at all places below the average, the defect being from 2°·0 to 3°·0 in the basins of the Obi, Yenisei, Amoor, and Peiho.

It has been stated that pressure was 0·244 inch above the average in South Greenland. At the two more northern stations however the excess was only 0·205 inch and 0·112 inch; and in accordance with this diminution of the pressure northwards over Greenland it is to be noted that whilst in the extreme south of Greenland the temperature was below the average, it rose above it at the stations further north successively to 0°·5, 3°·1, and 4°·0.

NOVEMBER, 1878, the U.S. Weather Map for which accompanies this notice, is memorable as the commencement of a period of unprecedentedly cold weather in the British Isles, which was protracted with scarcely even a temporary interruption to the middle of December, 1879.

In the United States pressure was above the mean to westward of the Mississippi and Missouri, the greatest excess, 0·090 inch, being near the sources of the latter river. Over the rest of the States and Canada pressure was under the average, there being at least three distinct centres of greater depression formed in this extensive region, one over Minnesota and Lake Winnipeg; a second along the St. Lawrence valley, and thence northward probably away towards the head of Baffin Bay, the greatest observed defect from the average being 0·131 inch near Anticosti; and a third along the north of the Gulf of Mexico. In Alaska pressure was fully half an inch below the mean of November.

But the most marked feature of the month was the development of a region of high pressure in mid-Atlantic and thence northward over Iceland and Greenland; the greatest excess, 0·362 inch above the average, occurring in the north-west of Iceland. Immediately to eastward an area of low pressure overspread the whole of Europe, rising however to the average on the southern, eastern, and northern, as well as on the western, limits of the continent. Within this extensive depression, just as in the American depression, were developed several centres of still greater depression, viz., in the Baltic, North Sea, north-west of France, and Corsica. Another area of low pressure extended over India, the Philippine Islands, the East Indian Archipelago, Eastern Australia, Tasmania, and New Zealand. Over the whole of the rest of Asia, the north and east of Africa, and the south and west of Australia atmospheric pressure was above the average.

The temperature anomalies in the United States were quite extraordinary. Within and immediately to eastward of the western barometric depression temperatures were from 12°·4 to 13°·7 above the normal for the month, and over this region southerly winds prevailed; whereas immediately to westward, winds were westerly and northerly, and temperature fell to 3°·4 above the normal, and on the Pacific coast to the normal. On the South Atlantic and Gulf States winds were northerly and the temperature only about half a degree above the normal. In connection with the St. Lawrence valley depression, the temperature anomalies were 6°·0 in the Upper Lake region, 4°·0 in Ohio valley, 3°·6 in the Lower Lake region, and 1°·0 in the St. Lawrence valley above the normal.

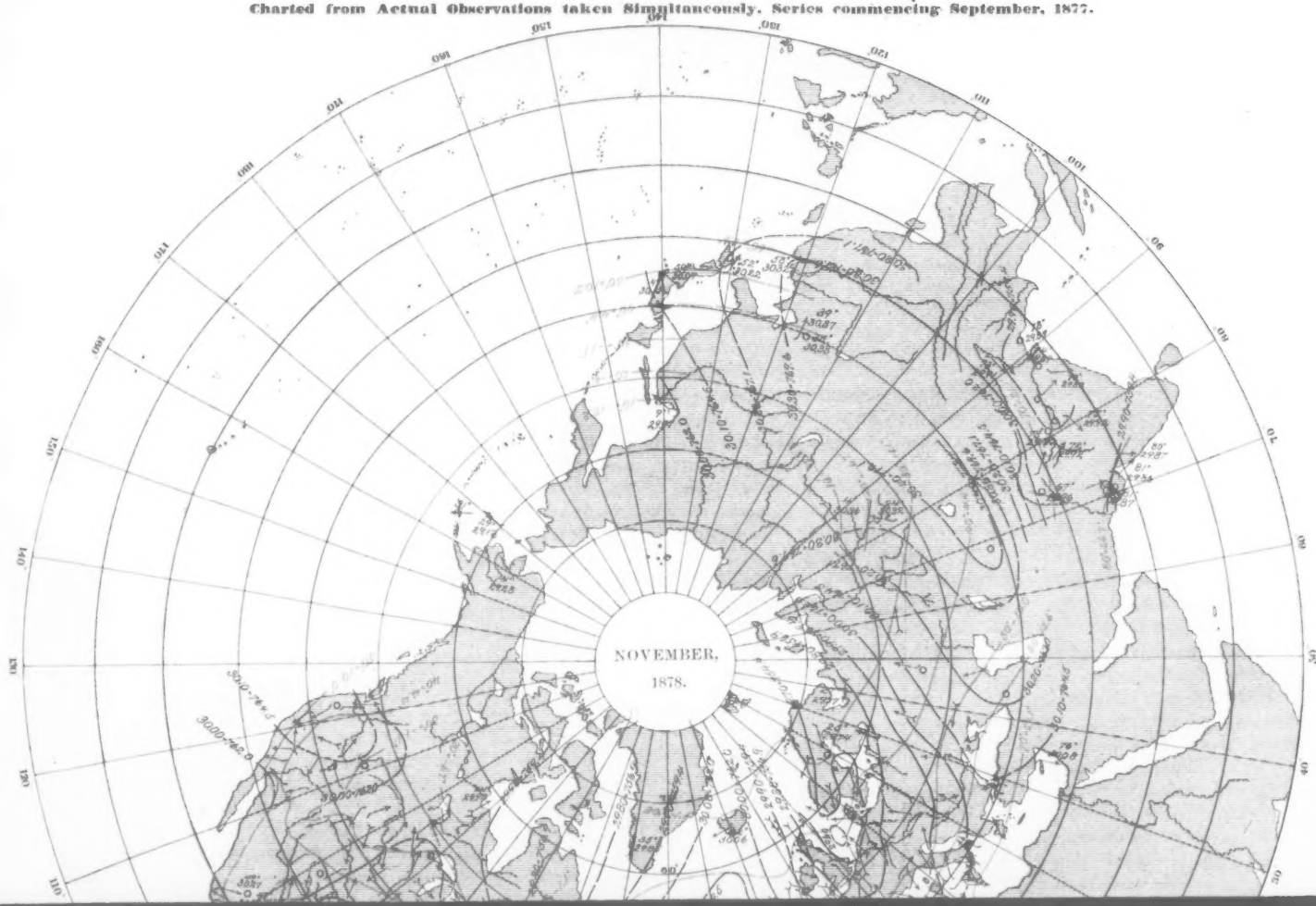
In the west of Greenland, the pressure anomalies of the three stations proceeding northward were 0·130 inch, 0·048 inch above, and 0·016 inch below the mean, and from the strong southerly winds resulting therefrom the temperature anomalies were respectively 6°·8, 9°·0, and 9°·5, almost rivalling the relative excesses of temperature which made the weather of this month so memorable over large portions of the States. As higher pressures

No. V.

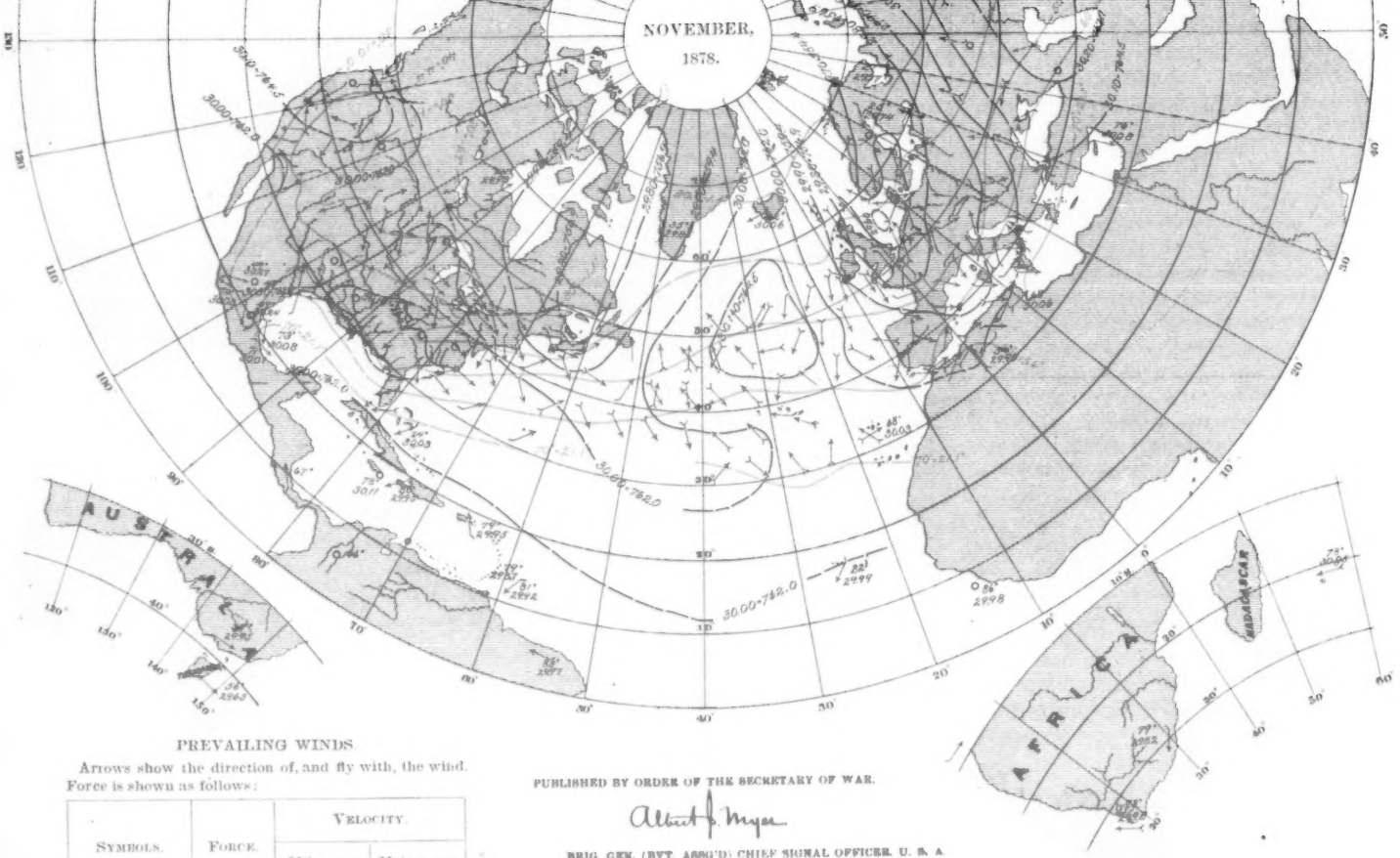
Office of the Chief Signal Officer,

UNITED STATES ARMY.

Charted from Actual Observations taken Simultaneously. Series commencing September, 1877.




NOVEMBER,
1878.



PREVAILING WINDS.

Arrows show the direction of, and fly with, the wind. Force is shown as follows:

Symbols.	Force.	Velocity.	
		Miles per hour.	Metres per second.
→	1, 2	0 to 9	0 to 4.0
→	3, 4	9.1 to 22.5	4.1 to 10.1
→	5, 6	22.6 to 40.5	10.1 to 18.1
→	7, 8	40.6 to 67.5	18.1 to 30.2
→	9, 10	67.6 up.	30.2 & over.

PUBLISHED BY ORDER OF THE SECRETARY OF WAR.

Albert J. Myer

BRIG. GEN. (BVT. ASSG'D) CHIEF SIGNAL OFFICER, U. S. A.

ISOBARS AND ISOTHERMS.

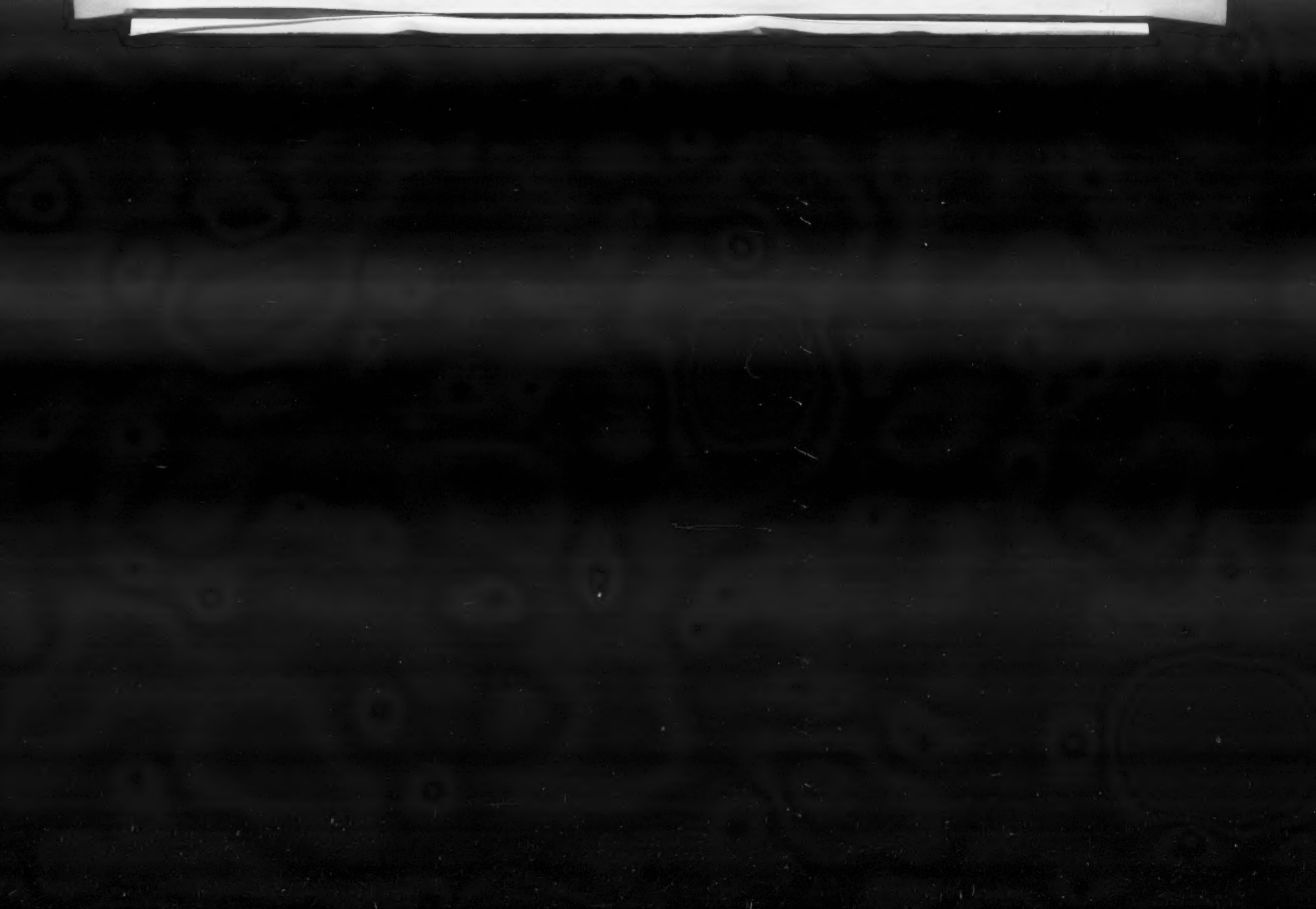
Isobars in *blue*; detached barometer means in English inches.

Isotherms in *red*; detached temperature means in degrees Fahrenheit.

Broken lines are doubtful.

INTERNATIONAL MONTHLY CHART.

Showing mean pressure, mean temperature, mean force and prevailing direction of winds at 7:35 A. M., Washington mean time, for the month of November, 1878, based on the daily charts of the International Bulletin.



ruled to westward from the North Cape to the Straits of Gibraltar, strong northerly winds swept over the whole of Western Europe, and the temperature everywhere fell below the average of the season, the defect being 4°·3 in the north of Norway, 4°·0 in Farö, 4°·4 in Islay, 2°·8 in Jersey, and 5°·6 in Portugal. This area of low temperature stretched eastward into Europe as far as Vienna, Trieste, and Mentone.

To the east of the line of lowest pressure within the great barometric depression which covered all Europe except its extreme outskirts, temperatures were above the average, and greatly so as far east as the head waters of Yenisei, and thence round by Taschkend, Syria, and the north of Africa. Over the greater portion of this broad region the excess was not less than 5°·0, and in the north of the Black Sea it reached as high as 9°·4 above the normal. In Eastern Siberia, Mantchooria, and Northern China very low temperatures prevailed, a deficiency of 8°·1 being recorded on the Upper Amoor.

The chief features of the meteorology of the northern hemisphere for November, 1878, and they are very striking, were these :—(1) The almost unprecedently high temperature, amounting to from 6°·0 to 13°·7 above the average over a large part of the United States, from 6°·8 to 9°·5 above the average over West Greenland; an excess of from 5°·0 to 9°·5 over nearly the whole of European Russia and Western Siberia; (2) large and extensive barometric depressions formed in conjunction with these most anomalous temperatures; and (3) the formation of an area of high pressure—inclosed within remarkably steep gradients of mean monthly pressure—over mid-Atlantic, extending thence in a north-easterly direction over Iceland toward Spitzbergen. To this it may be added that, whilst the high temperature anomaly of the surrounding low pressure regions rose to 13°·7 in the United States, 9°·5 in Greenland, and 9°·4 in Europe, the low temperature anomaly of the included region of high pressure fell only to 5°·6 below the normal at Coimbra, but over no great extent did it fall lower than 4°·0 below the normal.

The U.S. Weather Maps for December, 1878, and subsequent months, when low temperature anomalies were their out-standing features, will be looked forward to with the greatest interest as likely to throw light on the development of the meteorological conditions which impressed so arctic a character on our British weather during 1878–79. In connection with this large problem it is impossible to overestimate the vital importance of a serious and searching inquiry into the causes which brought about the high temperature anomalies of the United States, Greenland, and Russia. It is to these anomalies in all likelihood we must look for an explanation of the origin of the high pressure in the included region of the North Atlantic, which was undoubtedly the immediate cause of the strong northerly winds and low temperatures which then prevailed over Western Europe.

NOTES

PROF. W. CHANDLER ROBERTS, F.R.S., will deliver the introductory lecture to his course of Metallurgy, on Monday next, October 4, at three o'clock, at the Science Schools, South Kensington Museum.

MR. A. C. HADDON, Demonstrator of Comparative Anatomy in the University of Cambridge, with the sanction of the authorities, instead of conducting his class as usual during the Long Vacation at Cambridge, made the novel experiment last summer of taking it to the shores of Torbay, where he established a temporary zoological station on the principle of that at Naples, whither he himself had formerly been sent by the University to study. The attempt was very successful, and will doubtless be repeated another year. It was found that in addition to the ordinary class-fee of one guinea, a fee of four guineas covered the expenses of the extemporised laboratory, which was sufficiently provided with the instruments and appliances requisite in the present state of zoological study, as well as those of boat-hire for the dredging and surface-skimming excursions that formed the chief outdoor-work of the class, throughout the seven weeks of its stay; while embryological and histological dissections, together with the preparation and preservation of marine specimens for the University Museum, afforded constant occupation at home. The books, mostly monographs, needed for the determination and proper examination of the animals captured, were supplied by the superintendent of the museum, Mr. J. W. Clark, and the class received much valuable assistance from Mr. A. R. Hunt, whose intimate knowledge of the fauna of Torbay was freely placed at its disposal.

MR. MCGIBBON, the Superintendent of the Botanic Gardens, Cape Town, South Africa, a position which he has filled for thirty years, retires on a pension of 150*l.* a year. A movement is on foot to remove the Gardens from their present contracted site in Cape Town itself, and to create in the neighbourhood of the city a botanical establishment more worthy of the seat of South African Government. As a first step the appointment of Director has been offered to the well-known Cape botanist Prof. MacOwan, of Gill College, Somerset East. It is, however, doubtful whether the state of his health will allow of his undertaking it.

ON the 21st inst. there died at his residence in Camberwell, at the advanced age of 89, Charles Johnson, who for more than forty-four years held the post of Professor of Botany at Guy's Hospital. He was editor of Sowerby's "English Botany," author of "Grasses of Great Britain," "British Poisonous Plants," "Ferns of Great Britain," and other valuable contributions to natural history. In early life he took up the study of natural science, being one of the first members of the City Philosophical Society, of which Dr. Faraday and other eminent men were fellow-members. He was a high authority on agriculture and all subjects connected with economic botany.

THE death is announced of Prof. Samuel Stehman Haldeman, Professor of Comparative Philology in the Pennsylvania University, at the age of sixty-eight years. In 1836 he was employed in the geological survey of New Jersey, and in the following year in that of his native State, Pennsylvania. Dr. Haldeman filled the chair of Natural History in the University of Philadelphia and in a Delaware college, and was Professor of Geology and Chemistry to the State Agricultural Society of Pennsylvania prior to accepting the post which he held at his death. Other deaths announced are, on August 27, Dr. Hanstein, Professor of Botany and director of the Botanic Garden at Bonn; and on August 21, Prof. E. B. Andrews, of the Geological Survey of Ohio, the author of several important contributions to the geology of that State.

MR. DARWIN has forwarded to us an article contributed to an American medical journal by Dr. B. G. Wilder, Professor of Physiology in Cornell University, on "The Two Kinds of Vivisection—Sentisection and Callisection;" as he thinks the suggestion therein contained deserves consideration in this country. "All well-informed persons," Dr. Wilder writes, "are aware that the vast majority of vivisections, in this country at least, are performed under the influence of anæsthetics; but the enthusiastic zoölaters, who desire to abolish the objective method of teaching physiology, practically ignore this fact, and dwell chiefly upon the comparatively infrequent operations which are attended with pain. Having read the

arguments upon both sides and had some correspondence with leaders of the anti-vivisection movement, I have been led to think that the discussion may be simplified, and a right conclusion sooner reached, if we adopt new terms corresponding to the two kinds of experimentation. Having waited long in the hope that some candid discussion of the whole subject might contain the needed terms, I venture to suggest that painful vivisection be known as *sentisection*, and painless vivisection as *callisection*. The etymology of the former word is obvious; the distinctive element of the latter is the Latin *callus*, which, in a derived sense, may denote a nervous condition unrecognised, strictly speaking, by the ancients. Some idea of the relative numbers of callisectionists and sentisectionists may be gained from the fact that I have been teaching physiology in a university for twelve years, and for half that time in a medical school; yet I have never performed a sentisection, unless under that head should be included the drowning of cats, and the application of water at the temperature of 60° C. (140° F.), with the view to ascertain whether such treatment would be likely to succeed with human beings. I think that even elementary physiological instruction is incomplete without callisection, but that sentisection should be the unwelcome prerogative of the very few whose natural and acquired powers of body and mind qualify them above others to determine what experiments should be done to perform them properly, and to wisely interpret the results. Such men, deserving alike of the highest honour and the deepest pity, should exercise their solemn office not only unrestrained by law, but upheld by the general sentiment of the profession and the public."

AMERICAN papers speak of remarkable clouds of flies that have visited various districts. At East Pictou, Nova Scotia (about 44° 50′ N., 63° W.), such a cloud was seen on August 21. "They passed Lismore about six o'clock in the evening close to the shore. They went with the wind, which was blowing lightly from the west, occupying about twenty minutes passing a given point. They made a loud buzzing noise, which was heard by many who missed seeing them. They flew so low that some of them appeared to fall into the water. About two miles below Lismore they slightly changed their flight, heading more to the north. After their passage numbers of strange flies were observed in some of the houses near the shore. They were about half an inch in length, with wings proportionately longer than those of the common house-fly, but whether they belonged to the swarm is uncertain." At Halifax, Nova Scotia, immense swarms passed over Guysboro' (lat. 44° 40′ N., long. 61° 30′ W.), on September 5. They came from the east and resembled a dark cloud. A communication from Poughkeepsie, New York (lat. 41° 50′ N., long. 74° W.) states that a storm of flies was encountered on the Hudson River on the afternoon of September 4. The steamer *Martin*, bound south, encountered the fly storm between New Hamburgh and Newburgh. It seemed like a great drift of black snow, and it reached southward from shore to shore as far as the eye could reach. There were millions upon millions of the flies, and they hurried northward as thick as snow-flakes driven by a strong wind. They were long and black and had light wings, and the cloud must have been miles in length. Our readers may remember that some weeks ago we recorded a somewhat similar phenomenon as having been seen in various parts of France.

A VERY successful attempt has been made to measure a base-line, near Aarberg, for the triangulation of Switzerland. The first measurement gave 2400·087 metres; the second, made independently of the first, gave 2400·085 metres as the result, the difference between the two being thus only two millimetres. The measurement was made under the direction of the Spanish General Ibanez, who invented the instrument by which the work was done. The place selected for the line is on the Sisselen road, which presents here an almost straight and level line of three kilometres.

A CONGRESS is to be held from October 1 to 10 at Saragossa, to discuss matters relating to the phylloxera.

THE "Elephant Sugar Cane" of Cochin China, which is said, though this requires confirmation, to reach a height of eleven feet and a diameter of seven inches in six months, has been successfully introduced by the Royal Gardens, Kew, from Saigon, into Jamaica. The rather sensational reputation of this variety has excited a good deal of interest in it amongst the West Indian planters.

MR. ROLAND TRIMEN, the Curator of the South African Museum, has arrived in this country.

THE Annual Report of the Smithsonian Institute for 1878 shows that it continues to be as active as ever in the advancement of scientific knowledge. In all its departments a vast amount of work has been done during the year, much of this work being really of an international character. Many valuable additions were made to the National Museum during the year, and several monographs of the first importance published. One of the principal papers in the volume is a memoir of the late Prof. Joseph Henry, by Prof. Asa Gray. About 100 pages are devoted to a paper by Mr. W. B. Tayler on "Henry and the Telegraph," and another long paper describes Henry's researches on sound, with special reference to fog-signalling. Other papers are a translation of Arago's biography of Condorcet; Ernest Favre's biographical notice of Louis Agassiz; "The Effect of Irritation of a Polarised Nerve;" "Pflüger's Electrotonus," by Dr. B. F. Lautenbach; "Researches on Fever," by Dr. H. C. Wood; "Constants of Nature," by Prof. John LeConte; list of apparatus relating to heat, light, electricity, magnetism, and sound, available for scientific researches involving accurate measurements, in various institutions in the United States; "Ornithological Exploration of the Caribbee Islands," by Mr. F. A. Ober; "Report of Explorations in Greenland," by L. Kumlein.

VOL. XVI. of the *Transactions and Proceedings* of the Royal Society of Victoria contains the results of a very satisfactory year's work. The following are among the papers in this volume:—"On the Relation between Forest Lands and Climate in Victoria," by R. L. J. Ellery, F.R.S.; "Experiments on the Tensile Strength of a few of the Colonial Timbers," by Fred. A. Campbell, C.E.; "The Diorites and Granites of Swift's Creek and their Contact Zones, with Notes on the Auriferous Deposits," by A. W. Howitt, F.G.S.; "On the Genus Amathia of Lamaroux, with a Description of a New Species," by the Rev. J. E. Tenison-Woods, F.G.S., &c.; "Notes on the Customs of Mota, Banks Islands," by the Rev. R. H. Codrington, M.A., Oxford, with Remarks by the Rev. Lorimer Fison, Fiji; "Some New Localities for Minerals in Victoria," by J. Cosmo Newberry; "The Tidal Datum of Hobson's Bay," by R. L. J. Ellery, F.R.S.; "Notes on the Geology of the West Tamar District, Tasmania," by Norman Taylor; "Observations of the Outer Satellite of Mars in 1879," by E. J. White, F.R.A.S. Williams and Norgate are the London agents of this Society.

THE Government of India has offered the prize of 100*l.* for the best "Manual of Hygiene," to serve as a text-book for the use of the British soldiers in that country. Works submitted in competition for this prize must be sent in by their authors to the Secretary to the Government of India in the Military Department at Calcutta, so as to reach his hands not later than the last day of next March. The work is "to be written in clear and simple English, and thoroughly practical, showing the ordinary causes

affecting health, and the special dangers to which British soldiers are exposed in India, more particularly during their first year in the country, and the best means by which those dangers may be averted." The work, if accepted, will be printed at the public expense, and become the property of the State; and it is not to exceed in bulk "more than fifty or sixty pages of print, of small pica, octavo size."

AN ingenious method for obviating the frequent stoppage of trains at stations, and yet accommodating the passengers from these stations, has been devised by M. Hanrez. A "waiting carriage," comprising a steam-engine with special gear, and space for passengers and luggage, is placed on a siding at the station, and picked up by the train as it goes past. The latter, by means of a hook on its last carriage, catches a ring supported on a post, and connected with a cable wound on a drum in the waiting carriage. Thereupon the drum begins to unwind, and in doing so compresses a system of springs, while the carriage is moved at a rate gradually increasing to that of the train. The engine of the carriage then winds in the cable, the train and carriages are connected, passengers are transferred (the carriages being of the American type) from the joined carriage to the train, and *vice versa*, then the two are disconnected, and the engine of the carriage, working on the wheels, brings it back to the station whence it was taken.

MR. R. TUCKER writes:—A verification of M. Landry's statement (NATURE, vol. xxii. p. 495) may be acceptable:—

$$2^{58} + 1 = 2^{64} + 1 = 18446744073709551617$$
$$= 274177 \times 67280421310721.$$

THOSE of our readers who have girls to educate we recommend to consult the Queen's College Calendar for 1880-81, published by Macmillan and Co.

THE Sanitary Institute seems to have had a very successful meeting last week, all the usual topics embraced in its programme coming on for discussion. Dr. B. W. Richardson gave a very interesting and instructive lecture on "Woman as a Sanitary Reformer," one of the first conditions being her education in physiology and such other sciences and arts as bear on every-day household life. Dr. Richardson made it clear that if women were educated as they ought to be they would be an immense power in keeping houses and households in a healthy condition.

WE have received the new calendar of the Newcastle College of Science. The classes in this institution now include mathematics, experimental physics with laboratory, chemistry with laboratory, geology, including geological surveying, natural history, land surveying, mining, modern history, French, German, mechanical drawing.

ABOUT 88,000*l.* has now been subscribed towards the cost of the projected new University College at Liverpool, and little more will be needed to make up the amount required. It was originally intended to raise 80,000*l.* for the endowment of seven professorships and two lectureships; but part of the money subscribed (about 7,000*l.*) has been contributed towards the foundation of a Roscoe chair of art—a professorship not originally contemplated; Lord Derby gives 10,000*l.* to found a chair of natural history; Messrs. William, S. G., and P. H. Rathbone give a like sum to found a King Alfred chair of modern history and literature; Mr. A. H. Brown, M.P., and Messrs. Cressfield and Barrow also give 10,000*l.* to found a chair of ancient history; Mrs. Grant subscribes a similar amount to found a chair in some branch of science; and 10,000*l.* is given by the trustees of the late Mr. Roger Lyon Jones to the Royal Infirmary School of Medicine, to found a chair of experimental physics, with which mathematics will be for the time associated. Between 7,000*l.* and 8,000*l.* has been subscribed towards founding a chair of philosophy, logic, and political economy. Though the endowment funds are nearly complete, there remains the cost of a building to be provided.

WE have received from Madras Dr. Oppert's work "On the Weapons, Army Organisation, and Political Maxims of the Ancient Hindus, with special reference to Gunpowder and Firearms."

THE Aristotelian Society, which was founded last spring for the systematic study of philosophy, has just completed its work for this session, having studied philosophy from Thales to Proclus. The session for 1880-81 will open on October 11 at 20, John Street, Adelphi, at 8 p.m., when an introductory address will be delivered by the President, Mr. Shadworth H. Hodgson, LL.D., on "Philosophy in Relation to its History." During the session the Society intends to study mediæval philosophy, and the whole of modern philosophy, from Bacon to Comte and Spencer.

A SOCIETY for the Promotion of Agricultural Science has been formed in the United States, which will meet annually for the reading of papers, and which will in other ways endeavour to encourage scientific research in connection with agriculture. Such papers as are likely to be of permanent value will be published. Prof. W. J. Beal of Lansing, Michigan, is president of the society.

AT the last meeting of the Balloon Society a letter was read from M. de Fonvielle offering to bring over a balloon with a gas capacity of 42,000 feet, and compete with Mr. Wright in his balloon, both balloons to start simultaneously from the Crystal Palace in a contest for the longest aërial distance travelled in some particular direction. The proposal was referred to a committee.

WE have received a handsome quarto publication, "Contributions to the Archæology of Missouri, by the Archæological Section of the St. Louis Academy of Science." This first part is devoted to Pottery; it will be followed by others, the object being to furnish to those interested in the archæology of the country, a reliable statement of facts connected with the occurrence of prehistoric remains in this important region. The present volume contains a general description of the south-eastern Missouri district and of the pottery which has been found in such abundance in the burial mounds of that region. Several charts and plans and figures of characteristic specimens of the pottery, beautifully drawn and lithographed, have been selected for illustration. The authors of the two papers in the volume are Mr. W. B. Potter and Dr. E. Evans. Should the present venture meet with encouragement other volumes may soon be expected treating of "Implements," "The Construction and Grouping of Earthworks," and "Osteological Remains." We trust the enterprise will meet with the encouragement it well deserves. The volume is published by George A. Bates, Naturalists' Bureau, Salem, Mass.

AN unusually severe shock of earthquake was felt at Fribourg on Sunday, the 19th inst., about 11 a.m. A smart earthquake shock was felt at Morat at 8 o'clock, a.m., on the 21st, and another twelve hours later at Fribourg, which, though of shorter duration than that of Sunday, caused considerable alarm. An earthquake took place at Wellington, New Zealand, on July 28.

A SILESIAN Botanical Exchange Club has been established, evidently intended for the exchange of specimens among botanists of all countries. A copy of the rules may be obtained by applying to Herr Adolph Toepffer, Bandenburg an der Havel, Prussia.

DR. HECTOR, of the New Zealand Geological Survey, expresses his opinion that in Westland and Otago vast auriferous tracts remain as yet untouched.

"The Monthly Index to Current Periodical Literature, Proceedings of Learned Societies, and Government Publications," published at the office of the *American Bookseller*, New York, seems to us a very useful publication.

The passage of the meteor referred to in Mr. Thwaites' letter last week, occupied one and a half, not eleven and a half seconds.

The additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Major Gape; an Egyptian Jerboa (*Dipus ægyptius*) from Egypt, presented by Dr. Hastings; a Cape Bucephalus (*Bucephalus capensis*) from South Africa, presented by Mr. C. B. Pillans; two Black-faced Spider Monkeys (*Ateles ater*) from East Peru, a Southern River Hog (*Potamochærus africanus*) from South Africa, a Razor-billed Curassow (*Mitua tuberosa*) from Guiana, a Yarrell's Curassow (*Crax carunculata*) from South-East Brazil, a Blue and Yellow Macaw (*Ara ararauna*), two Orinoco Geese (*Chenalopex jubata*) from South America, two Rufous Tinamous (*Rhynchotus rufescens*) from Brazil, deposited; a Common Rhea (*Rhea americana*) from South America, a Spotted-billed Toucanet (*Selenidera maculirostris*) from Brazil, an Electric Silurus (*Malapterurus beninensis*) from West Africa, purchased.

BIOLOGICAL NOTES

Transverse Commissure in Arthropods. — From a recent memoir laid before the Belgian Academy by M. Lienard (*Archives de Biologie*, tom. i. fasc. 2), it would appear that an arrangement of the cephalic nerve-centres, hitherto thought to have been peculiar to Crustacea, is really to be found in nearly the whole of the Arthropoda. It has been long known that in Crustaceans, *e.g.*, Decapoda, besides the super and sub-œsophagean ganglionic masses and their lateral connections, there is a well-marked transverse commissure, situated in front of the sub-œsophagean mass, and immediately behind the œsophagus. This commissure in other Arthropoda seems, from quite technical causes, to have escaped notice. M. Lienard finds it nearly everywhere among the Myriapoda, Coleoptera, Odonata, Lepidoptera, Hemiptera, Diptera (nymphs and larvæ). He has dissected the complete ring in nearly 100 forms, belonging to 70 genera. He is trying to ascertain the origin of the fibres which form the transverse commissure.

The Hæmatopœtic Function.—In a recent paper to *R. Accademia dei Lincei*, Sig. Fleti describes the effects of splenotomy as observed by him in dogs. Some of these are as follows:—Immediately after the operation (the previous *régime* of life being maintained) the quantity of hæmoglobin increases for a short time, and more in old than in young animals. Next it diminishes much and progressively in old animals, but without reaching half the normal quantity. In a third phase there is a slow progressive increase, which by degrees brings the quantity up to and above the normal. In young animals the diminution is much less, and the quantity of hæmoglobin sooner reaches and surpasses the normal. In all cases the weight of the animal does not diminish, but may even considerably increase (under good hygienic and alimentary conditions). Sig. Fileti adds some chemical observations as to colorations obtained with hydrochloric acid and yellow prussiate of potash. It clearly appears (he concludes) that, the spleen being removed, the marrow of the bones does not compensate for its function. As the quantity of hæmoglobin first increases—and we cannot admit a real increase in production as resulting from splenotomy—we must suppose that in this brief period the failure of the spleen makes itself felt more in destruction than in production. The former of these functions comes to be compensated more quickly, and there is then a gradual diminution in production of hæmoglobin as a direct consequence of the spleen being absent, and this diminution is greater the less able the marrow is to act, *i.e.* the older the animal. When, finally, the hæmatopœtic function of the spleen has been completely compensated by the marrow of the bones, the quantity of hæmoglobin returns to the normal figure, and may even surpass it. Sig. Fileti is studying the influence of light on the production of hæmoglobin.

Development of Lepidosteus.—In an interesting memoir read at the last meeting of the British Association (Swansea) Prof. F. M. Balfour and Mr. W. N. Parker gave the results of their investigations of some larval forms of Lepidosteus which had been most liberally supplied to them by Prof. Alexander Agassiz. Some of the more important of these were:—1. That the segmentation was, as in the sturgeon, complete, but the larger segments of the lower pole very early fused together to form a yolk sac. 2. That the epiblast was divided into nervous and epidermic layers, and that the nervous system was formed by a solid thickening of the epiblast, as in Teleostei, and not by the closure of a groove, as in the sturgeon. 3. That the lens of the eye and auditory vesicle were developed from the nervous layer of the epidermis. 4. That the general relation of the embryo to the yolk, and the general characters of the germinal layers are precisely like those in Teleostei. 5. That there is present a suctorial disk in front of the mouth, with numerous papillæ, as was first noticed by Agassiz; this disappears in the adult, and is probably a persisting rudiment of a primitive vertebrate organ, remains of which are also found in the adhesive papillæ of larval ascidians, the adhesive disks of larval amphibians, &c.

Visceral Anatomy of Herring.—Mr. F. W. Bennett calls attention to the following, it would seem new, fact in the visceral anatomy of this common fish (*Journ. Anat. and Physiol.*, July, 1880). It possesses an extremely long air-bladder, which stretches towards to the head, terminating near the labyrinth of the auditory organs. About the middle of its length it is connected by a duct with the stomach. The latter is capacious and elongated; while the commencement of the mid-gut is near the gullet the posterior portion of the stomach continues on into the ductus pneumaticus. This communication will be found most usually closed with mucus; but Mr. Bennett points out that there is another and a more important communication between the air-bladder and the cloaca. Till within one half-inch of this latter the air-bladder retains its well-known and beautiful silvery appearance; this then suddenly ceases, and the remainder of the bladder is muscular. This will account perhaps for its having been overlooked so long; what the exact uses of this passage may be are not yet known, but it is certain that it affords freer passage for gas than the duct leading into the stomach. Bristles may be readily passed through it, and gas may be made to bubble out if slight pressure be carefully applied under water. The usual arrangement of the apertures of the cloaca is as follows:—In front lies the anus, then the generative aperture, and hindmost of all, the urinary duct opens; the opening of the duct now described by Mr. Bennett lies between the anus and the urinary aperture, and usually to the left of the genital aperture.

Monstrous Beetles.—Mr. Horace F. Jayne has recently published, in the *Trans.* American Entom. Soc., vol. viii. pp. 155–62, Pl. IV., descriptions of some monstrosities observed in North American Coleoptera, all of which belong to that class to which the terms "Monstra per excessum" and "Monstres polyméliens" have been applied. They belong to the genera *Calosoma*, *Cychrus*, *Metrius*, *Pasimachus*, *Scarites*, *Dyschirius*, *Chlænius*, *Lichnanthe*, *Polyphylla*, *Strategus*, *Telephorus*, *Prionus*, *Eleodes*, and *Helops*, and form an interesting addition to the already numerous recorded instances of this kind of monstrosity in beetles. All show a tendency to reduplication in some of the cephalic or thoracic appendages. In some it is the antennæ, in others the palpi, in others the legs, that are thus affected, and in some cases the tendency is exhibited in more than one of these appendages in the same individual. Beetles appear to be particularly liable to the production of such monstrosities, but it is probable that no parallel instance like that here recorded and illustrated by Mr. Jayne in an example of a longicorn beetle (*Prionus californicus*) has been noticed. In it each maxillary palpus has two terminal joints, and each femur has two perfectly-formed tibiæ and tarsi, with the claws, &c., the whole monstrous development being remarkably symmetrical; the labial palpi and the antennæ are normal, as is all the rest of the insect. Mr. Jayne contents himself by describing and figuring these interesting monsters, and does not venture upon any suggestions as to causes, in which he is perhaps wise, considering the uncertainty that exists as to the origin of parallel monstrosities in animals far higher in the scale. Reduplication of cephalic, thoracic, and probably abdominal appendages in the Arthropoda is by no means rare, but it is possible that a distinct combination of two individuals more or less united in one, such as is sometimes found in vertebrates, does not exist.

DIGESTION IN PLANTS.—Dr. Lawson Tait has recently investigated afresh the Digestive Principle of Plants. While he has obtained complete proof of a digestive process in *Cephalotus*, *Nepenthes*, *Dionæa*, and the *Droseraceæ*, he entirely failed with *Sarracenia* and *Darlingtonia*. The fluid separated from *Drosera binata* he found to contain two substances, to which he gives the names "droserin" and "azerin." Dr. Tait confirms Sir J. D. Hooker's statement that the fluid removed from the living pitcher of *Nepenthes* into a glass vessel does not digest. A series of experiments led him to the conclusion that the acid must resemble lactic acid, at least in its properties. The glands in the pitchers of *Nepenthes* he states to be quite analogous to the peptic follicles of the human stomach; and when the process of digestion is conducted with albumen, the products are exactly the same as when pepsine is engaged. The results give the same reactions with reagents, especially the characteristic violet with oxide of copper and potash, and there can be no doubt that they are peptones.

STIPULES IN ONAGRACLÆ.—Prof. Baillon says (*Bull. mensuel. Soc. Lin. de Paris*, No. 33) that in the majority of works on descriptive botany, this family is mentioned as characterised by the constant absence of stipules, and in justification of this quotes the classical works of Decaisne, Duchartre, Endlicher, and Hooker; nevertheless he states that the existence of these organs in this family admits of easy proof, not indeed that they ever occur of large dimensions, for then they could not have escaped detection, but still they are present, more commonly as little subulate tongue-like bodies, acute, often red-coloured at the base of the petioles in both opposite and alternate-leaved plants. In Hauya they soon turn black and wither off early. In the fuchsia of our gardens little stipules are often present. In Circea they can also be detected. In the Lopezia of our gardens all the leaves have two very distinct stipules, which indeed have been often referred to in botanical works, and it is the same with Haloragia, though Bentham and Hooker describe them as here absent.

A NEW GREEN CILIATED PLANT.—Under the title of "A New Ciliated Organism furnished with Chlorophyll," Prof. van Tieghem has published (*Bull. Soc. Bot. France*, 1880, p. 130) a memoir of a strange new form. The organism in question was found by Prof. Perrier twice: once at Roscoff, in sea-water containing algæ and some of the lower animals; and again at the Museum (Paris), in a little aquarium in the laboratory. It presents the appearance of a gelatinous tremulous mass of a pure green colour; in outline well defined, spherical or oval in shape, attaining more than a centimetre in diameter, and attached by a portion of its periphery to a large marine alga. At first sight it would be called a Nostoc. Exposed to sunlight it gave out oxygen, so one concludes its colouring-matter to be chlorophyll. On a closer inspection it is seen that the mass is composed of a colourless jelly, scattered throughout which are isolated green points, visible to the unassisted eye, and sufficiently numerous as to give to the whole mass the green coloration distinguishing it, so one would not now refer it to Nostoc. Each little green body is spherical, and measures from three to four-tenths of a millimetre. It is formed of a very finely granular and somewhat dark protoplasm, very uniformly permeated with an amorphous chlorophyll; neither nuclei nor vacuoles, nor red spot were detected, and the surrounding membrane was very thin. At one place (called the pole) the cell bore a tuft of vibratile cilia which were attached side by side, so as to cover a space more or less large according to age and to allow of independent movements. On the equator at two diametrically opposite points a small hollow in the green mass is seen, and by these passes a band of homogeneous protoplasm which traverses the membrane, turning towards the pole, and in the superior hemisphere dividing on its outer border into fine fringes with vibratile cilia. These cilia are confluent at their base, and are not independent in their movements. In process of development the polar cilia become detached (absolutely fall off), next the lateral moustaches disappear (these seem to be retracted), a continuous membrane covers over all, but the general aspect and dimensions remain unchanged. Later on the cell divides into two (equatorially), next it divides again (perpendicularly), and the segmentation continues until there is a family of sixteen rounded-off cells, and the organism has passed through a phase of encystment. Lastly each daughter cell increases in size, separates more and more from its neighbour, gets closed in a fine membrane, and then appears all covered over with cilia. It now escapes into the water and secretes in abundance a gelatinous material. The clothing of cilia drops off as the form approaches its adult size: soon appear the polar cilia, next the lateral moustaches; and so far its life-history is complete. At no phase in its development was either cellulose detected in its cell-membrane, nor starch in its protoplasm. Prof. van Tieghem concludes:—"Is this organism an animal or a plant? I am not well able to say, and I must add besides that this question, to which formerly so much importance attached, in the actual condition of science, appears to me to be destitute of interest." It is called *Dimystax perrieri*. With every respect to the dictum of so distinguished a botanist as Prof. Tieghem, we venture to call our readers' attention to this strange form, which M. Roze seems disposed to regard as an animal, in the hopes that some of them may assist in determining its proper position in nature.

PHYSICAL NOTES

A FRESH measurement has been made by Mr. T. C. Mendenhall of the acceleration of gravity at Tokio, an account of which appears in the *American Journal of Science*. The experiments were made after the accepted methods with Kater's and Borda's pendulums, the only novelty introduced being that of employing a chronograph in connection with a reliable chronometer to determine the time of vibration of the pendulum. At every sixtieth or hundredth vibration of the pendulum a light break-circuit apparatus placed beneath it was raised to just such a height as to be "thrown" by the pendulum at its lowest point of swing, thus enabling its rate to be calculated to the ten-thousandth of a second. Mr. Mendenhall considers his determinations to be more reliable than those of Professors Ayrton and Perry, which were made with a long wire pendulum; he revises their calculations, altering their value of "g" from 9·7974 to 9·7979, and asserts that their calculation of the theoretical value by Clairaut's formula is wrong, and should be 9·7980, not 9·797 (metres). His own determinations give a mean result of 9·7984.

A SECONDARY battery, the electrodes of which consist of porous fragments of gas-carbon, has been devised by M. Henri Sauvage. Though inferior in power and durability to a perfectly "formed" Planté cell with lead electrodes, this cell would be cheaper, more readily and rapidly constructed, and would yield a current of longer duration. The action is probably due to the occlusion of the hydrogen and oxygen gases respectively in the pores of the carbon. The inventor recommends that the two plates used as electrodes be kept apart with a simple thin wooden frame.

PROF. O. N. ROOD calls attention to the fact that when the colour of ultramarine blue is mixed with white by the method of rotating disks the tint appears to verge towards violet. Brücke advanced the explanation that what we call white is really a reddish colour. Aubert, on the contrary, regarded it as showing that violet is only a pale shade of ultramarine blue. A series of experiments made with other colours showed that when mixed thus with white green-yellow becomes greenish, and green green-bluish, that full yellow and orange incline to red, and red becomes purplish. These observations accord with neither theory, and Prof. Rood advances none himself. He thinks that the fact as it stands explains why it is impossible in the polariscope to produce a red free from purplish tint, there always being white light mingled with the red rays.

PROF. J. TROWBRIDGE, in investigating with telephones connected to earth-plates the flow of return-currents through "earth," found that at a mile from the Harvard College Observatory the time-signals of the observatory clock could be heard by merely tapping the earth at points fifty feet apart.

FROM his recent researches on dilatation and compressibility of gases under strong pressures, M. Amagat derives (*Comptes rendus*, August 30) the following laws:—1. The coefficient of dilatation of gases (for temperatures not too much above the critical) increases with the pressure to a maximum, then decreasing indefinitely. 2. This maximum occurs under the pressure with which the product $p v$ is minimum, where the gas accidentally follows Mariotte's law. 3. It diminishes for higher and higher temperatures, and at length disappears. 4. At a sufficiently high temperature the compressibility of fluids is represented by the formula $p(v - a) = \text{const.}$; a being the smallest volume the mass of fluid can occupy; this is the limiting law. For each gas a has a special value. 5. For pressures

below the critical the deviation (from Mariotte's law), first positive for a temperature sufficiently low, becomes *nil*, then negative, with increasing temperature; but beyond a certain negative value it diminishes indefinitely without changing sign. 6. For pressures between the critical pressures and a superior limit, special for each gas, the period during which the deviation is positive is preceded at a lower temperature by a period in which it is negative; so that the deviation twice changes sign. 7. Beyond the upper limit of pressure indicated in the preceding law the deviation is always negative, whatever the temperature; it diminishes, in general, when the temperature increases, except for pressures near the limit, where its variation is more complicated.

IT is known that rain and other meteoric waters contain a quantity of gas and saline matters which they find in the atmosphere and carry with them. The amount varies with the seasons, but may be estimated, on an average, at about 8 cc. of oxygen, and 0·50 to 0·60 cc. carbonic anhydride per litre, along with small quantities of ammonia, nitrite, nitrate, and carbonate of ammonium, organic matters, and chloride of sodium. In a recent paper to the Belgian Academy M. de Koninck holds that in the alteration and metamorphism of rocks by infiltration of those waters may be found the solutions of many questions in geology hitherto unsolved. The facts he cites relate to tertiary and quaternary deposits which in many parts of Belgium are so transformed by the waters in question that it is impossible to recognise them if account be taken only of petrographic characters.

FROM observing how different persons gave different estimates of the apparent size of blood-corpuscles seen in the microscope, M. Montigny was led to make a series of further experiments on the subject (which are described in the *Bulletin* of the Belgian Academy, No. 6). He comes to the conclusion that even for good observers an estimation of the kind referred to is principally affected by the length of distinct vision, but that often this appreciation is subject to the influence of occult causes which affect the relation between sensation and judgment. The examination of microscopic objects may be influenced, like astronomical observations, by a kind of *personal error*, by reason of which individuals have a tendency to see microscopic images, some larger, others smaller, than they should appear, abstraction being made of the influence of the length of distinct vision on our appreciations. These conclusions, it is pointed out, do not at all affect the exactness of measurements determined by *savants* with the microscope, but they tend to show that each observer should measure for himself the different magnifying powers of the instrument he uses, obtained by changes of eye-pieces and objectives.

WITH the view of demonstrating the mechanical action of electrolysis, all action of heat being excluded, Signor Basso has lately experimented thus (*Il Nuovo Cim.*, ser. 3, tom. vii.). A thin square glass plate is covered with collodion, and on this when dry is put a thin layer of good gelatine, mixed with about $\frac{1}{15}$ of its weight of a saturated solution of bichromate of potash. The bare side of the plate is exposed to light, to attach the gelatine layer. Then the plate is put in an aqueous solution of chloride of gold till the upper layer is impregnated with the gold salt, and it is exposed to diffused daylight. Next the covered side is strewed with fine graphite, and the glass connected by means of four fine wires running along its sides to the negative pole of a battery. The plate is then placed in an ordinary bath of sulphate of copper. The copper is deposited regularly on the whole of it. In a few days wrinkles and bubbles appear; and if the copper have been deposited as far as the borders, the plate may at length even break, thus proving the mechanical force, which is a direct consequence of electrostriction.

ON THE PRESENT STATE OF SPECTRUM ANALYSIS[1]

AT the Sheffield meeting of the British Association a committee was appointed to report on the present state of spectrum analysis. The committee has this year presented its first report. The report is divided into four parts:—

1. On the spectra of metalloids, drawn up by Dr. A. Schuster.
2. On the influence of temperature and pressure on the spectra of gases, drawn up by Dr. A. Schuster.
3. On the emission spectra of the rays of high refrangibility, drawn up by Prof. W. N. Hartley.
4. On the absorption spectra of the rays of high refrangibility, drawn up by Prof. A. K. Huntington.

In the report on the spectra of metalloids, we have for each element a full account of the literature on the subject with all necessary references. The various spectra of each metalloid and its compounds are enumerated, and special stress is laid on the discussion which nearly always has taken place on the chemical origin of these spectra. It will be found that often more work is needed to clear up doubtful points, but there is no special controversy at issue at the present moment except in the case of the carbon spectra. A discussion of very long standing is still occupying the minds of many spectroscopists as to whether the spectrum which is seen at the base of every candle flame is due to carbon or to a hydrocarbon. The arguments and experiments on either side are given in detail and are finally summed up as follows:—"Those who believe the spectrum to be due to the element carbon rely chiefly on the brilliancy with which these bands are developed when cyanogen is burnt in oxygen, also when the spark is taken in cyanogen, carbon tetrachloride, and carbonic oxide at high pressure; all the gases being dried with the greatest care. Those who oppose this view and who hold that the spectrum is due to a hydrocarbon refer to the impossibility of excluding all traces of moisture, and to the fact that this spectrum is well developed under circumstances where we know hydrocarbons to be present."

When cyanogen is burnt a series of bands appears in the blue violet and ultra-violet, and another controversy has taken place whether these bands are due to carbon or to a compound of carbon and nitrogen. Two papers have lately appeared on the subject. One by Mr. Lockyer, in which he describes an experiment in which the bands were seen in a spark taken in carbon tetrachloride, although the nitrogen lines were not visible in the jar discharge; and another by Professors Liveing and Dewar, in which these bands were traced to impurities of nitrogen in all cases in which they were seen. A spark in carbonic oxide showed the bands when the gas was prepared from ferrocyanide of potassium, but not when it was made by heating a mixture of quicklime with pure and dry potassium oxalate. When all the air had been properly expelled a tube containing carbon tetrachloride did not show the bands.

The following quotation will give an idea of the points which are discussed in the second report:—

"We shall endeavour for clearness' sake to arrange our material under five different heads. We shall first discuss what changes we have a right to expect in the appearance of a spectrum, if the quantity of luminous matter is increased or if the temperature is raised, the absorbing properties of the gas remaining unaltered. We shall next speak of the widening of lines, which, as we shall see, often accompanies an increase of pressure. Then we shall treat of the different spectra given by one and the same body at different temperatures; and we shall see how far satisfactory explanations have been offered for their existence.

"So far our road will be clear; but we shall see that these spectra of different orders, as they have been called, are only extreme cases of continuous changes which are nearly always going on. Very often we can refer these continuous changes to a gradual displacement of one spectrum by another; but often we shall not be able to prove the existence of a second spectrum. There is *à priori* nothing impossible or even improbable in the view that the relative intensity of different lines may be different at different temperatures, and often when we observe a variation we may equally well explain it by assuming the gradual appearance of a new spectrum or an alteration only in the relative intensities of the lines. It becomes then a matter of extreme difficulty to decide which of the two suppositions is correct. In doubtful cases we may often be able to obtain important information by means of a method which is little understood even by spectroscopists. It is the method which has first been extensively used and investigated by Mr. Lockyer of projecting an image of the luminous source, spark, arc, or flame on the slit of the spectroscope and thus localising the spectra, which are thrown and confused together if the luminous source is examined directly without the interposition of a lens. We shall see how by means of this method we shall often at a single glance be able to tell how the body will behave at different temperatures and under different pressures. Many facts which have been quoted as remarkable might have been foretold by means of this method. Our fourth chapter will be devoted to it. In our last chapter we

[1] Abstract of Report read at the Swansea meeting of the British Association.

shall have to give an account of some changes which have not found a place under the previous heads."

Space will only permit us to quote a few of the questions raised. It is now generally admitted that pressure is the principal cause which determines the widening of lines, but it is not generally known that a different appearance of the lines may be presented according as the pressure is due to the impact of similar or dissimilar molecules; thus a molecule of sodium will widen its lines more easily in an atmosphere of sodium than in another atmosphere. Mr. Lockyer has observed that the lines of oxygen or nitrogen may be obtained sharp at atmospheric pressure by mixing a small quantity of one gas with the other. The gas which is present in small quantities has its lines sharp.

The curious fact is mentioned that when a line widens unsymmetrically it widens in nearly all cases more towards the red, and then towards the violet end.

In that part of the report which relates to multiple spectra an account is given of the gradual spreading of the opinion that these spectra are due to different molecular groupings. The question of long and short lines is next discussed, and great stress is laid on the fact that the longest lines are by no means always the strongest. An abstract of Mr. Lockyer's work on the subject is given, and of the confirmation which his results have found in later work. Thus Mr. Lockyer found that the longest lines were always the first to be reversed. Professors Liveing and Dewar have since examined the absorption-spectra of many metallic vapours. The lines which they have seen reversed were nearly in all cases those which are longest in the spark, though not always those which are strongest. Results obtained by M. Lecoq de Boisbaudran with sparks, the temperature of which was lower than in the ordinary jar-discharge, also confirm Mr. Lockyer's results. Discussing the attempts which have been made to explain these and other facts, it is again mentioned that we must assume the impacts of a similar molecule to produce a greater effect than the impacts of a dissimilar one. The last part of the report treats of some other changes in the relative intensities of lines. We only mention the experiments in which Mr. Lockyer found sometimes the green sodium line to be present without the well-known yellow double line. The report concludes as follows:—

"We have here again two hypotheses, that of molecular shocks and that of molecular combinations. Both explain the facts satisfactorily, and I do not think that one of them necessarily excludes the other. I believe, on the contrary, that a line can be drawn, and that while the regular changes observed chiefly in band-spectra may be due to one cause, the often irregular changes in metallic spectra, where one set of lines disappears and another appears often on the violet side, but sometimes towards the red, may be due to another cause.

"It is often said that we must not ascribe the same phenomenon to two different causes, when one of them is sufficient to explain it; but the point at issue is whether the phenomena are the same in all cases. An advance of science has constantly led to the separation of phenomena which were formerly considered to be connected together, and we believe that the further development of the different points we have attempted to discuss, in which different observers have strongly taken up opposite opinions, will lead to the blending together of different views rather than the entire elimination of one of them."

Prof. Hartley, in his part of the report, gives us an account of our knowledge on emission spectra in the ultra-violet region. He treats especially of the researches on the solar spectrum by Mascart, Draper, and Cornu.

Prof. A. K. Huntington reports on the absorption spectra in the ultra-violet region. The results obtained by Prof. Stokes and Dr. Miller are given in detail. Amongst the results obtained by Dr. Miller, it seems especially interesting to notice the connection which apparently exists between the absorbing properties of a liquid and that of its vapour. When one of them is transparent to the ultra-violet rays the other is also, and *vice versâ*.

Prof. Soret, it is well known, constructed a few years ago a spectroscope with a fluorescent eyepiece, and has by means of it carried researches in the ultra-violet parts of the spectrum. We notice especially the examination of absorption-spectra of the bases of gadolinite, and the conclusions drawn from it on the existence of new elementary bodies. Prof. Cornu has given much attention to the absorption power of our atmosphere, and we find a full account of his experiments in Prof. Huntington's report. In conclusion we have a short abstract of the work done by Professors Hartley and Huntington on absorption-spectra in the ultra-violet region. They obtained the following results:—

1. The normal alcohols of the series $C_4H_{2n-1}OH$ are remarkable for transparency to the ultra-violet rays of the spectrum, pure methylic alcohol being nearly as much so as water.

2. The normal fatty acids exhibit a greater absorption of the more refrangible rays of the ultra-violet spectrum than the normal alcohols containing the same number of carbon atoms.

3. There is an increased absorption of the more refrangible rays corresponding to each increment of CH_2 in the molecule of the alcohols and acids.

4. Like the alcohols and acids, the ethereal salts derived from them are highly transparent to the ultra-violet rays, and do not exhibit absorption-bands.

Interesting results were also obtained by the examination of substances containing the benzene nucleus, and in a separate paper the absorption-spectra of essential oils were examined and discussed. Prof. Hartley has still further extended the researches jointly begun with Prof. Huntington, and has arrived at the conclusion that no molecular arrangement of carbon atoms causes selective absorption, unless three pairs are doubly linked together in a closed chain.

It will be seen that a few only of the branches of spectrum analysis have been discussed in the present report, and next year no doubt will bring us a further instalment of a work which we hope will prove useful to those who are interested in spectroscopic investigations.

AGRICULTURAL CHEMISTRY[1]

III.

I HAVE thus far directed attention to some points of importance in connection with the sources of the constituents of our crops, and I must now briefly refer to some in connection with the composition, and to some relating to the uses, of the crops themselves.

As to composition, I must confine myself to indicating something of what is known of the condition of the nitrogen in our various crops; though I had intended to say something respecting the carbohydrates, and especially respecting the various members of the cellulose group.

As to the nitrogen—in our first experiments on the feeding of animals, made in 1847, 1848, and 1849, the results of which were published in the last-mentioned year—we found that, in the case of succulent roots used as food, not only were they not of value as food in proportion to their richness in nitrogen, but when the percentage of it was higher than a certain normal amount, indicating relative succulence and immaturity, they were positively injurious to the animals. So marked was the variation of result according to the condition of maturity or otherwise of of the foods employed, that, when reviewing the results of the experiments which had up to that time been conducted, in a paper read before this Section of the British Association at the Belfast meeting in 1852 (and which was published in full in the annual volume[2]), we stated that the mode of estimating the amount of proteine compounds by multiplying the percentage of nitrogen by 6·3 was far from accurate, especially when applied to succulent vegetable foods, and that the individual compounds ought to be determined. The Rothamsted laboratory staff was however much smaller then than it is now, and with the pressure of many other subjects upon us, it was at that time quite impossible to follow up the inquiry in that direction.

It is indeed only within the last ten years or so that the question has been taken up at all systematically; but we are already indebted to E. Schulze, A. Urick, Church, Sachsse, Maercker, Kellner, Vines, Emmerling, and others, for important results relating to it.

Our knowledge in regard to the subject is however still very imperfect. But it is in progress of investigation from two distinctly different points of view—from that of the vegetable physiologist and that of the agricultural chemist. The vegetable physiologist seeks to trace the changes that occur in the germination of the seed, and during the subsequent life-history of the plant, to the production of seed again. The agricultural

[1] Opening Address in Section B (Chemical Science), at the Swansea meeting of the British Association, by J. M. Gilbert, Ph.D., F.R.S., V.P.C.S., F.L.S., President of the Section. Continued from p. 499.

[2] "On the Composition of Foods in relation to Respiration and the Feeding of Animals."

chemist takes the various vegetable products in the condition in which they are used on the farm, or sold from it. And as a very large proportion of what is grown, such as grass, hay, roots, tubers, and various green crops, are not matured productions, it comes to be a matter of great importance to consider whether or not any large proportion of the nitrogenous contents of such products is in such condition as not to be of avail to the animals which consume them in their food?

We cannot say that the whole of the nitrogen in the seeds with which we have to deal exists as albuminoids. But we may safely assume that the nearer they approach to perfect ripeness the less of non-albuminoid nitrogenous matters will they contain; and in the case of the cereal grains at any rate, it is probable that if really perfectly ripe they will contain very nearly the whole of their nitrogen as albuminoids. With regard to some leguminous and other seeds, which contain peculiar nitrogenous bodies, the range may however be wider.

But whatever the condition of the nitrogenous bodies in the seeds we grow or sow, with germination begins a material change. Albuminoids are transformed into peptones, or peptone-like bodies, or degraded into various amido- or other compounds. Such change into more soluble and more diffusible bodies is, it is to be supposed, essential to their free migration, and to their subserviency to the purposes of growth. In the case of the germination, especially of some leguminous seeds, asparagine has been found to be a very prominent product of such degradation of the albuminoids; but it would seem that this disappears as the green parts are developed. But now the plant begins to receive supplies of nitrogen from the soil, as nitrates or ammonia, and it would seem that amides constitute a considerable proportion of the produced nitrogenous bodies, apparently as an intermediate stage in the formation of albuminoids. At any rate, such bodies are found to exist largely in the immature plant; whilst the amount of them diminishes as the plant, or its various parts, approach to maturity.

But not only have we thus, in unripened vegetable productions, a greater or less, and sometimes a very large, proportion of the nitrogenous bodies formed within the plant, existing as amido-compounds, but we may have a large amount existing in the juices as nitric acid, and some as ammonia, &c. Thus, E. Schulze determined the nitric acid in various "roots;" and he found that, in some mangels, more than one-third of the total nitrogen existed in that form, and about one-tenth as much as ammonia. In a considerable series at Rothamsted, we have found an extremely variable proportion existing as nitric acid, according to the size, succulence, or degree of maturity, of the roots; the amount being, as a rule, the least with the ripest and less highly nitrogenous roots, and the most with the most succulent, unripe, and highly nitrogenous ones. In some cases it reached as much as from 20 to nearly 30 per cent. of the total nitrogen. In many other immature vegetable products nitric acid and ammonia have been found; but, so far as I remember, in none in anything like so large a proportion as in the so-called "root-crops," especially mangels. In many, however, the quantity appears to be immaterial; and it is remarkable that whilst there is so much in the "roots," little or none is found in potatoes.

No wonder that, in the experiments already referred to, we found the feeding result to be the worse the more succulent and immature the roots, and the higher their percentage of nitrogen, accordingly.

But it is to the difference in amount of the albuminoid bodies themselves, in different descriptions of vegetable produce, that I wish specially to direct attention, making, however, some reference to what is known of the proportion of the nitrogen existing as amido-compounds.

In some mangels E. Schulze found only from about 20 to 22 per cent. of their total nitrogen to exist as insoluble and soluble albumin. But he found in one case 32·5, and in the other 40·8 per cent. of the total nitrogen as amides. In a large series of determinations at Rothamsted, by Church's method, we found a variation of from under 20 to over 40 per cent. of the total nitrogen of mangels to exist as albuminoids; or, in other words, from nearly 60 to over 80 per cent. of it in the non-albuminoid condition.

In potatoes Schulze found from under 50 to 65 per cent. of the total nitrogen as soluble and insoluble albumin, and from 27·7 to 49·1 per cent. as neutral and acid amides. In a series of potatoes grown at Rothamsted, under very various conditions as to manuring, and in two different seasons, we found the nitrogen as albuminoids to range from little over 50 to more than 71 per cent. of the total nitrogen, leaving, of course, from less than 30 to nearly 50 per cent. to be accounted for in other ways.

Kellner determined the amount of nitrogen as albuminoids, and as amido-compounds, in a considerable series of green foods, both leguminous and gramineous, cut at different stages of their growth. The proportion of the total nitrogen not as albuminoids was, upon the whole, greater in the leguminosæ than in the gramineæ. In both, however, the proportion as albuminoids increased as the plants approached to maturity. The proportion as albuminoids was in all these products very much larger than in roots, and generally larger than in potatoes. In the case of first-crop meadow-hay we found in the separated gramineous herbage 76·4, in the leguminous herbage 82, and in the miscellaneous herbage 80·3 per cent. of the nitrogen as albuminoids; and in the second crop 86·2 per cent. in the gramineous, 88·3 per cent. in the leguminous, and 88·1 per cent. in the miscellaneous herbage. How far the higher proportion of the nitrogen as albuminoids in the second crops is to be taken as any indication of the characteristics of the autumn growth, or how far it is to be attributed to the accidental condition of the weather, may be a question.

These illustrations are sufficient to give some idea of the range and proportion of the nitrogen in different feeding crops which does not exist as albuminoids; and they are sufficient to show that a very large proportion of the non-albuminoid matter exists as various amido-compounds. The question arises, therefore, whether these bodies contribute in any way to the nutrition of the animals which feed upon them? We have but little experimental evidence on this point. As green herbage is the natural food of many descriptions of animal, we might suppose that characteristic constituents of it would not be without some value as food; but the cultivated root crops are much more artificial productions, and it is in them that we find such a very large proportion of non-albuminoid nitrogen. With respect to some of the amido compounds, at any rate, direct experiments seem to show that they are digested in the animal body, and increase the elimination of urea. Weiske and Schrodt found that rabbits receiving, as their only nitrogenous food, either asparagine or gelatin, wasted and died; but a rabbit receiving both asparagine and gelatin increased in weight and survived to the end of the experiment, which lasted seventy-two days. From the results of other experiments made with sheep, they concluded that both asparagine and gelatin protect the albuminoids of the body from oxidation.

These considerations lead me, in conclusion, to refer briefly, and I promise it shall be as briefly as is consistent with clearness, to the two very much disputed questions of *the origin of muscular power*, and *the sources of the fat of the animal body*. These subjects Mr. Lawes and myself have frequently discussed elsewhere; but as the controversy has assumed a new phase quite recently it seems desirable and appropriate that I should recur to it on the present occasion.

With regard to the question of the sources in the food of the fat of the animal body, Liebig originally maintained that although fat might be formed from the nitrogenous compounds within the body, the main source of it in the herbivora was the carbohydrates. In his later writings he sharply criticised the experiments and arguments of those who have maintained the formation of fat chiefly from the proteine compounds, but he at the same time seems to attach more importance to that source than he formerly did. He gives it as his opinion that the question cannot be settled by experiments with herbivora. He adds that what we know with certainty is that, with these animals, albuminates and carbohydrates work together to produce fat; but whether the non-nitrogenous product, fat, has its origin in the albumin or in the carbohydrate he considers it not easy to determine.

At the time when we commenced our experiments on the feeding of animals in 1847 the question whether the fat of the animals fed for human food was mainly derived from albuminoids or from carbohydrates had been scarcely raised, or at least it was not prominent. The question then was rather—whether the herbivora received their fat ready formed in their food, or whether it was produced within the body—the latter view being that which Liebig had so forcibly urged, at the same time maintaining that at any rate its chief source was the carbohydrates. Accordingly our experiments were not specially arranged to determine whether or not the whole of the fat produced could or could not be derived from the albuminoids.

For each description of animal, oxen, sheep, and pigs, such

foods as had been established by common experience to be appropriate were selected. The general plan of the experiments was to give to one set a fixed amount of a recognised good food, containing known quantities of nitrogen, fatty matter, &c., to another set the same amount of another food, of different characters in these respects; to other sets also fixed amounts of other foods in the same way: and then there was given to the whole series the same complementary food *ad libitum*. Or, to one set was supplied a uniform food rich in nitrogen, and to others uniform foods poorer in nitrogen, and so on, in each case *ad libitum*.

It will be seen that in this way a great variety of dietaries was arranged, and it will be observed that in each case the animals themselves fixed their consumption according to the requirements of the system.

As already indicated, the individual nitrogenous and non-nitrogenous compounds of the foods were not determined. As a rule, the constituents determined were—the total dry matter, the ash, the fatty matter, and the nitrogen; from which last the amount of nitrogenous compound it might represent was calculated by the usual factor. But, as already said, the results so obtained were only used with considerable reservation, especially in the case of all immature vegetable produce. Nor was the crude fibre determined; but, as in the case of the estimated nitrogenous substance, when interpreting the results, it was always considered whether or not the food contained much or little of probably indigestible woody matter.

The animals being periodically weighed, we were thus able to calculate the amounts of the so-estimated nitrogenous substance, and of the total non-nitrogenous substance, including and excluding fat, consumed—*for a given live-weight within a given time*, and *to produce a given amount of increase in live-weight*.

Experiments were made with a large number of sheep and a large number of pigs. And, even without making allowance for the different condition of the nitrogenous or of the non-nitrogenous constituents, in comparable foods, the results so uniformly indicated that, both the amount consumed by a given live-weight of animal within a given time, and that required to produce a given amount of increase, were determined much more by the amount of the non-nitrogenous than by that of the nitrogenous constituents which the food supplied. And when allowance was made for the different condition of the nitrogenous constituents, and for the greater or less amount of the non-nitrogenous ones which would probably be indigestible and effete, the indications were still more remarkable and conclusive.

In very many cases the animals were slaughtered, and carefully examined as to whether the tendency of development had been more that of growth in frame and flesh, or in fatness. Here, again, the evidence was clear, that the tendency to growth in frame and flesh was favoured by a high proportion of nitrogen in the food, and that to the production of fat by a high proportion of digestible non-nitrogenous constituents.

In a few cases the actual amount of fat in the animals in the lean, and in the fat condition, was determined; and the results admitted of no doubt whatever that a very large proportion of the stored-up fat could not have been derived from the fatty matter of the food, and must have been produced within the body.

So decisive and consistent were the very numerous and very varied results in regard to these points, that we had no hesitation in concluding—not only that much of the fat stored up was produced within the body, but that the source of much, at any rate, of the produced fat must have been the non-nitrogenous constituents of the food—in other words, the *carbohydrates*.

As already stated, however, as the question whether the source of the produced fat was the proteine compounds or the carbohydrates was not then prominent, we had not so arranged the experiments as to obtain the largest possible increase in fat with the smallest possible supply of nitrogenous compounds in the food, nor did we then even calculate whether or not there was sufficient nitrogenous matter consumed to be the source of the whole of the fat produced.

This question, indeed, excited very little interest, until, at a meeting of the Congress of Agricultural Chemists held at Munich in 1865 (at which I happened to be present), Prof. Voit, from the results of experiments made in Pettenkofer's respiration apparatus with dogs fed on flesh, announced his conclusion that fat must have been produced from the nitrogenous substance, and that this was probably the chief, if not the only, source of the fat, even of herbivora—an opinion which he subsequently urged much more positively.

In the discussion which followed the reading of Prof. Voit's paper, Baron Liebig forcibly called in question his conclusions; maintaining not only that it was inadmissible to form conclusions on such a point in regard to herbivora, from the results of experiments made with carnivora, but also that direct quantitative results obtained with herbivorous animals had afforded apparently conclusive evidence in favour of the opposite view.

Voit's paper excited considerable controversy, in which Mr. Lawes and myself joined. We maintained that experiments to determine such a question should be made not with carnivora or omnivora fed on flesh, but with herbivora fed on their appropriate fattening food, and on such herbivora as common experience showed to be pre-eminently fat-producers. We pointed out[1] that the pig comprised, for a given live-weight, a comparatively small proportion of alimentary organs and contents; that, compared with that of the ruminants, his food was of a high character, yielding, for a given weight of it, much more total increase, much more fat, and much less necessarily effete matter; that, in proportion to his weight, he consumes a larger amount of food, and yields a larger amount, both of total increase and of fat, within a given time; and, lastly, that he contains a larger proportion of fat, both in a given live-weight and in his increase whilst fattening.

It is obvious that with these characteristics there is much less probable range of error in calculating the amount and the composition of the increase in live-weight in relation to the amount and composition of the food consumed, than in the case of ruminants; and that therefore the pig is very much more appropriate for the purpose of experiments to determine the sources in its food of the fat it produces.

Accordingly we calculated a number of our early experiments made with pigs, to determine whether or not the nitrogenous substance they consumed was sufficient for the formation of the fat they produced. For simplicity of illustration, and to give every possible advantage to the view that nitrogenous substance might have been the source of the produced fat, we assumed the whole of the crude fat of the food to have been stored up in the animal—thus estimating a minimum amount to be produced. Then again we supposed the whole of the nitrogenous substance of the food to be perfectly digested, and to become available for the purposes of the system. Lastly, after deducting the amount of nitrogenous substance estimated to be stored up as such, the whole of the remainder was reckoned to be so broken up that no other carbon-compounds than fat and urea would be produced.

The result was that, even adopting these inadmissible assumptions in all the cases in which, according to common experience, the food was admittedly the most appropriate for the fattening of the animal, the calculation showed that a large amount of fat had been produced which could not have been derived from the nitrogenous substance of the food, and must therefore have had its source in the carbohydrates. Such a result is moreover entirely accordant with experience in practical feeding.

Reviewing the whole subject in great detail in 1869, Prof. Voit refers to these results and calculations. He confesses that he has not been able to get a general view of the experiments from the mass of figures recorded, and from his comments he shows that he has on some points misunderstood them. He admits, however, that as the figures stand, it would appear that fat had, in some instances, been derived from the carbohydrates. Still, he says, he cannot allow himself to consider that a transformation of carbohydrates into fat has thus been proved.

Prof. Emil von Wolff again in his "Landwirthschaftliche Fütterungslehre," referring to the same experiments, admits that they are almost incomprehensible unless we assume the direct concurrence of the carbohydrates in the formation of fat. He nevertheless seems to consider that evidence of the kind in question is inconclusive; and he suggests that experiments with pigs should be made in a respiration apparatus to determine the point.

Mr. Lawes and myself entertained, however, the utmost confidence that the question was of easy settlement without any such apparatus, provided only suitable animals and suitable foods were selected. I, accordingly, gave a paper on the subject in the *Section für Landwirthschaft- und Agricultur-Chemie*, at the Naturforscher Versammlung, held at Hamburg

[1] "On the Sources of the Fat of the Animal Body," *Phil. Mag.*, December, 1866.

in 1876.[1] The points which I particularly insisted upon were—that the pig should be the subject of experiment; that he should be allowed to take as much as he would eat of his most appropriate fattening food, so that his increase, and the fat he produced, should bear as large a proportion as possible to his weight, to the total food, and to the total nitrogenous substance consumed. Finally, it was maintained that, if these conditions were observed and the constituents of the food determined, and those of the increase of the animal estimated according to recognised methods, the results could not fail to be perfectly conclusive without the intervention either of a respiration apparatus or of the analysis of the solid and liquid matters voided.

Results so obtained were adduced in proof of the correctness of the conclusions arrived at. We at the same time admitted that although, for reasons indicated, we had always assumed that fat was formed from the carbohydrates in the case of ruminants as well as of pigs, yet, as in our experiments with those animals we had supplied too large amounts of ready-formed fat, or of nitrogenous matter, or of both, it could not be shown so conclusively, by the same mode of calculation in their case as in that of pigs.

In the discussion which followed, Prof. Henneberg agreed that it seemed probable that fat could be formed from the carbohydrates in the case of pigs. In the case of experiments with other animals, however, the amount of fat produced was too nearly balanced by the amount of fat and albuminous matters available, to afford conclusive evidence on the point.

Quite recently Prof. Emil von Wolff (*Landwirthschaftliche Jahrbücher*, Band viii. 1879, Supplement) has applied the same mode of calculation to results obtained by himself with pigs some years ago. He concluded that the whole of the body fat could not have been formed without the direct co-operation of the carbohydrates of the food. But what is of greater interest still is that he also calculated in the same way the results of some then quite recent experiments of Henneberg, Kern, and Wattenberg, with sheep. He thus found that, even including the whole of the estimated amides with the albumin, there must have been a considerable production of fat from the carbohydrates; and, excluding the amides, the amount reckoned to be derived from the carbohydrates was of course much greater.

I will only add, on this point, that on recalculating some of our early results with sheep, which did not afford sufficiently conclusive evidence when the whole of the nitrogen of the food was reckoned as albumin, show a very considerable formation of fat from the carbohydrates if deduction be made for the probable amount of non-albuminoid nitrogenous matter of the food.

We have now, then, the two agricultural chemists of perhaps the highest authority, both as experimenters and writers on this subject on the continent, giving in their adhesion to the view, that the fat of the herbivora, which we feed for human food, may be, and probably is, largely produced from the carbohydrates. I dare say, however, that some physiologists will not change their view until Voit gives them sanction by changing his, which, so far as I know, he has not yet done.

The question which has been currently entitled that of "The Origin of Muscular Power," or "The Sources of Muscular Power," has also been the subject of much investigation, and of much conflict of opinion, since the first publication of Liebig's views respecting it in 1842.

As I have already pointed out, he then maintained that the amount of muscular tissue transformed, the amount of nitrogenous substance oxidated, was the measure of the force generated in the body. He accordingly concluded that the requirement for the nitrogenous constituents of food would be increased in proportion to the increase of the force expended. In his more recent writings on the subject, he freely criticises those who take an opposite view. He nevertheless grants that the secretion of urea is not a measure of the force exerted; but, on the other hand, he does not commit himself to the admission that the oxidation of the carbohydrates is a source of muscular power.

The results of our own early and very numerous feeding experiments were, as has been said, extremely accordant in showing that, provided the nitrogenous constituents in the food were not below a certain rather limited amount, it was the quantity of the digestible and available non-nitrogenous constituents, and not that of the nitrogenous substance, that determined—both *the amount consumed by a given live-weight within a given time*, and *the amount of increase in live-weight produced*. They also showed that one animal, or one set of animals, might consume two or three times as much nitrogenous substance in proportion to a given live-weight within a given time as others in precisely comparable conditions as to rest or exercise. It was further proved that they did not store up nitrogenous substance at all in proportion to the greater or less amount of it supplied in the food, but that the excess reappeared in the liquid and solid matters voided.

So striking were these results, that we were led to turn our attention to human dietaries, and also to a consideration of the management of the animal body undergoing somewhat excessive labour, as, for instance, the hunter, the racer, the cab-horse, and the foxhound, and also pugilists and runners. Stated in a very few words, the conclusion at which we arrived from these inquiries (which were summarised in our paper given at Belfast in 1852) was, that unless the system were overtaxed, the demand induced by an increased exercise of force was more characterised by an increased requirement for the more specially respiratory, than for the nitrogenous, constituents of food.

Soon afterwards, in 1854, we found by direct experiments with two animals in exactly equal conditions as to exercise, both being in fact at rest, that the amount of urea passed by one feeding on highly nitrogenous food was more than twice as great as that fed on a food comparatively poor in nitrogen.

It was clear therefore that the rule which had been laid down by Liebig, and which has been assumed to be correct by so many writers, even up to the present time, did not hold good—namely, that "The sum of the mechanical effects produced in two individuals in the same temperature is proportional to the amount of nitrogen in their urine; whether the mechanical force has been employed in voluntary or involuntary motions, whether it has been consumed by the limbs or by the heart and other viscera"—unless, as has been assumed by some experimenters, there is, with increased nitrogen in the food, an increased amount of mechanical force employed in the "involuntary motions" sufficient to account for the increased amount of urea voided.

The question remained in this condition until 1860, when Bischoff and Voit published the results of a long series of experiments made with a dog. They found that, even when the animal was kept at rest, the amount of urea voided varied closely in proportion to the variation in the amount of nitrogenous substance given in the food—a fact which they explained on the assumption that there must have been a corresponding increase in the force exercised in the conduct of the actions proceeding within the body itself in connection with the disposal of the increased amount of nitrogenous substance consumed. Subsequently, however, they found that the amount of urea passed by the animal was, with equal conditions as to food, &c., no greater when he was subjected to labour than when at rest; whilst, on the other hand, the carbonic acid evolved was much increased by such exercise. They accordingly somewhat modified their views.

In 1866 appeared a paper by Professors Fick and Wislicenus, giving the results obtained in a mountain ascent. They found that practically the amount of urea voided was scarcely increased by the labour thus undertaken. Prof. Frankland gave an account of these experiments in a lecture at the Royal Institution in the same year; and he subsequently followed up the subject by an investigation of the heat developed in the combustion of various articles of food, applying the results in illustration of the phenomena of the exercise of force.

Lastly, Kellner has made some very interesting experiments with a horse at Hohenheim, the results of which were published last year. In one series the experiment was divided into five periods, the same food being given throughout; but the animal accomplished different distances, and drew different weights, the draught being measured by a horse-dynamometer. The changes in live-weight, the amount of water drunk, the temperature, the amount of matters voided, and their contents in nitrogen, were also determined.

The result was that with only moderate labour there was no marked increase in the nitrogen eliminated in the urine; but that with excessive labour the animal lost weight and eliminated more nitrogen. Kellner concluded, accordingly, that, under certain circumstances, muscular action can increase the transformation of albumin in the organism in a direct way; but that, nevertheless, in the first line is the oxidation of the non-nitrogenous matters—carbohydrates and fat, next comes in requisition the circulation-albumin, and finally the organ-albumin is attacked.

In reference to these conclusions from the most recent experi-

[1] The substance of that communication is given in the *Journal of Anatomy and Physiology*, vol. xi. part iv.

ments relating to the subject, we may wind up this brief historical sketch of the changes of view respecting it, with the following quotation from our own paper published in 1866:[1]—"... all the evidence at command tended to show that by an increased exercise of muscular power there was, with increased requirement for respirable material, probably no increased production and voidance of urea, unless, owing to excess of nitrogenous matter in the food, or a deficiency of available non-nitrogenous substance, or diseased action, the nitrogenous constituents of the fluids or solids of the body were drawn upon in an abnormal degree for the supply of respirable material."

In conclusion, although I fully agree with Voit, Zuntz, Wolff, and others, that there still remains much for both Chemistry and Physiology to settle in connection with these two questions of "The Sources of the Fat of the Animal Body" and "The Origin of Muscular Power," yet I think we may congratulate ourselves on the re-establishment of the true faith in regard to them, so far at least as the most important practical points are concerned.

THE GERMAN ASSOCIATION

THE fifty-third congress of the Association of German Naturalists and Physicians has been held at Danzig during the past week. At the first general meeting on Saturday, September 18, Dr. H. Abegg, who filled the post of president, in a brief speech of welcome to his colleagues expressed his pleasure at finding that the congress was so numerously attended. There had been fears that Danzig, owing partly to its somewhat isolated position, would have kept many from visiting it who would otherwise have come, had the point of meeting been fixed in a more southerly part of Germany. But these fears were wholly groundless; from far and near he was rejoiced to see additions to their body; and to all and each of his esteemed colleagues he bade hearty welcome.

Herr von Ernsthausen, Prof. Bail, and the Chief Burgomaster of Danzig, also gave short addresses, in which they confirmed the sentiments of the President.

So far as the reports in the admirable *Tageblatt* go, the following are some of the principal papers and lectures:—

The first paper read was by Prof. Hermann Cohn of Breslau, "On Writing, Type, and the Increase of Shortsightedness." Myopia, *i.e.*, shortsightedness, or the inability to distinguish objects at a distance, was, as he said, rarely or never born with the subject; it is generally induced by an injurious method of study which strains the eye during childhood. In 1865 the Professor began to collect statistics such as the schools in his own native town offered to him, and from these he was able to establish the following facts:—

1. That cases of shortsightedness occur rarely in village schools; their frequency increases in proportion to the demand made upon the eye in higher schools and colleges; so that in gymnasia myopia is most prevalent.

2. That the number of shortsighted scholars in all schools and colleges increases in proportion as one examines the higher grades or classes.

3. That the average of myopia increases from class to class; *i.e.*, those who are shortsighted become more and more so.

These conclusions have since met with universal confirmation. Among the causes which tend to increase the malady, the Professor specified school-desks constructed regardless of hygienic principles, lesson-books of which the typography is cramped and indistinct, and badly and insufficiently lighted schoolrooms. All these as they now existed were more or less unsatisfactory, and could bear alteration with perceptible benefit to the scholar. Indeed to make reforms in this direction was, as he showed, the duty of the State; and he hoped that a Government commission might ere long be appointed to regulate the construction of school-desks, the typography of lesson-books, and the lighting of class-rooms. By this means the evil which was so rapidly increasing might be met, and the percentage of shortsightedness thereby reduced to a far lower minimum than was at present the case.

The next address was given by Prof. Eduard Strasburger of Jena, "On the History and the present State of the Cell Theory." Having sketched at some length the growth and the development of this theory, the learned professor remarked in conclusion:—

"The results of research into cell-structure are well adapted to teach us a great deal about the complicated nature of the fundamental substance of life; and complicated this must be, to produce such a series of phenomena in constant succession. We have merely to accustom ourselves to regard protoplasm, not as a simple substance, but, on the contrary, as a highly organised body, or we have otherwise no means of explaining the phenomena of life. It is at any rate a fact that a lump of protoplasm, the ovum, is capable, after union with another particle of protoplasm, of reproducing the entire parent organism in its complicated structure. That the properties of an egg are not essentially different from those of other protoplasm, but that rather only one part of the protoplasm in the egg is specially suited for reproduction is proved by the fact that other masses of protoplasm in the organism become often capable of reproducing it in a perfect form. The behaviour of *Begonia* leaves is specially striking; and I therefore submit a specimen of them to you. It is well known that new plants are engendered from such leaves. Microscopical investigation shows us that in these leaves there are separate epidermal cells which reproduce the whole plant; the protoplasm of a single such cell affords, therefore, the basis for an entirely new organism. Thus the process does not differ in principle from the formation of a germ from the egg.

"The attributing of all the functions of life to protoplasm is to be looked upon as a great advance in science; although it is impossible for us, so far, even to form hypotheses with regard to the forces which are at work in the protoplasm. It will be the task of the future to throw light upon this side of the question. Shall we ever be able to gain a deeper insight into the final, the invariable causes of life? At the present it were futile to attempt this. The progress which science has made in the last ten years, often yielding quite unexpected results, leads us to hope for yet further advance; and in the seeking for knowledge, rather than in its final acquisition, it is that our highest pleasure lies."

In the sectional sitting for Mathematics and Astronomy held on the following Monday, September 20, Director B. Ohlert read a paper "On the Rapid Motion of the inner Moon of Mars in the light of Laplace's Theory." He pointed out that the fact that the inner moon of Mars passes round the planet in a far shorter time than the latter needs for rotation on its own axis would seem to be in contradiction to the hypothesis of Laplace on the origin of our planetary system. The lecturer further showed that there was nothing very remarkable in the *rapidity of the motion of this moon*, which, owing to the slight distance from Mars, was wholly in agreement with the third law of Kepler; but rather that an explanation was needed of the *slow axial motion of the planet itself*, and similarly of the other planets And hereupon Prof. Ohlert adduced proofs from which, according to his view, and in conformity with the assumption of Laplace, the rapidity of the axial motion of the planets in the final period of their formation would of necessity become diminished.

Dr. Franz then followed with a paper "On the Observation of Double-Stars made at the Königsberg Observatory, and on certain Peculiarities of the Königsberg heliometer."

The Section for Anthropology and Prehistoric Research held a sitting on the same day, with Dr. Stieda in the chair. Dr. Anger of Elbing exhibited a rich collection of anthropological specimens, chiefly illustrating the antiquity of the district.

In the Botanical Section Prof. Bail read a valuable paper "On Underground Fungi," in which he stated that the several species and varieties of these in Germany must certainly exceed the usually accepted number.

Prof. Moebius of Kiel, in the Section for Zoology and Comparative Anatomy, read (also on the same day) an interesting monograph "On the Importance of the Foraminifera for the Doctrine of Descent."

He began by quoting Dr. Carpenter's view that the genera and species of the Foraminifera cannot be determined after the usual method, but that the only natural classification of the great mass of different forms is to arrange them in accordance with their degree of relationship. Prof. Moebius himself had come to the conclusion from his researches among the Foraminifera which he had collected in Mauritius in 1874 that the repeatedly occurring peculiarities among the Foraminifera may serve and must serve us in forming an idea of their nature and zoological position.

The sarcode of the Foraminifera behaves with regard to the formation of the skeleton and shell just as does the protoplasm of the eggs of the Metazoa to the formation of the germs and of all organs proceeding from them. Like the protoplasm of the egg, it possesses a quite definite and hereditary capacity for self-development.

[1] Food in its relations to various exigencies of the animal body.—*Phil. Mag.*, July.

As confirmatory of Darwin's theory of descent, they possess a value neither greater nor less than that of all other animal classes. The lecturer's forthcoming work on the Foraminifera of Mauritius will contain much detailed evidence in support of his views.

In the discussion which followed, Herr Wacker suggested that the point of difference between Carpenter and Moebius lay in the fact that Carpenter had regard to the sarcode rather than to the skeleton, to which latter Moebius attached the greater importance.

The second paper was given by Dr. Gabriel, whose subject was "The Classification of the Gregarinæ." He objected to Stein's classification, hitherto the sole and undisputed one, on the grounds that it no longer fully represented the existing state of our knowledge. This view he was able to support, which he did at some length, and submitted to his hearers a new classification of his own.

In the Section for Anatomy and Physiology Prof. Tauber of Jena lectured upon "Two New Anæsthetics," with which he had experimented upon frogs, rabbits, and dogs. Both anæsthetics produced a scarcely appreciable change in the pulse and respiration, on which account they might be of great value for surgery. And in demonstration of their action Dr. Tauber proceeded to experiment upon a pigeon and a rabbit.

On Tuesday, September 21, at the second general sitting, Prof. Moebius of Kiel read a paper "On the Food of Marine Animals." In the sea therefore is generated by far the greater number of animal types, and these again in quantity and in bulk are throughout regulated by the existing supply of nourishment. This in its turn depends upon the organic matter of plants, which in the sea also supply nourishment to its inhabitants. In our own seas, the North Sea and the Baltic, marine grasses are discoverable near the coast, while twenty to fifty metres lower are other kinds of plants; deeper still, if we search, we shall find few or none. Loose strips of plants that have been torn away from their roots have been brought up from a depth of some hundred metres; in the Baltic and the North Sea these form a dark, soft, spongy mass. Nothing living is visible in this if placed in a tub; but if strained through a sieve, tiny mussels, snails, and crustacea become visible. In the depths of the sea-mud lining the bottom are countless worms, mussels, and little animals which feed upon the spongy mass. Flounders and other fish penetrate into these mud-depths and devour the animals that are there. Where the sea-bottom however is formed of soft clay, nothing beyond a few worms here and there will be found. Thus in the deeper portions of the Mediterranean, otherwise so rich in animal life, nothing at all is discoverable. The Professor in the course of his remarks went on to show that the supply of nourishment to the inhabitants of the sea was now and would be hereafter undiminished; and thus that the propagation of animal life in the sea would continue unchecked, so long as the mighty ocean itself should last.

SCIENTIFIC SERIALS

Bulletin de l'Academie Royale des Sciences (de Belgique), No. 7.—A Hyperoodon captured on the strand at Hillion (Côtes-du-Nord, France) in December, 1879, by M. van Beneden.—On Mysticetes with short fins, from the sands in the neighbourhood of Antwerp, by the same.—On determination of albuminoid substances of the blood serum by circumpolarisation (modified method of Hoppe Seyler), by M. Fredericq.—Contribution to a study of the *rôle* of insects in the pollinisation of heterostylous flowers (*Primula elatior*), by Mr. MacLeod.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, September 20.—M. Wurtz in the chair.—The following papers were read:—On the odours of Paris, by M. Sainte-Claire Deville. He analysed some of the moist black earth exposed in a trench in the Rue St. Jacques. The amount of salts in the impregnating liquid indicates considerable concentration (which can be easily explained). The dust from horses' shoes and from wheels of vehicles is thought to be the origin of sulphides and protoxide of iron, and of the dark coloration. The escape of gas, estimated at about a tenth of the gas circulating in the pipes, furnishes part of the sulphur, the carbonated hydrogen and the coal-tar which abounds. Through this escape the sub-soil is rendered wholesome (in the author's opinion), and cannot exhale any dangerous odour. There is a slight smell of sulphuretted hydrogen (not worse than that from sulphurous mineral waters), and a smell of healthy empyreumatic products.—M. de Tchihatchef presented a work of his on Spain, Algeria, and Tunis, but treating chiefly of Algeria. Such questions as the material and moral results of the annexation to France, the mode of action of the new administrative and social institutions, the assimilation of the Arab and the Christian elements, &c., are treated; the author has also studied the geology and botany of the country.—Observations of the new planet Coggia (287) at the Paris Observatory (equatorial of the western tower), by M. Bigourdan.—On a new experiment for showing the direction of the rotation communicated by bodies to polarised light, by M. Govi. A pure spectrum is produced with rectilinearly polarised light, and a plate of rock crystal is interposed, giving a dark band; also an analyser. The spectrum and analyser have a joint movement of rotation (one end of the spectrum being at the centre of the circle of which the spectrum represents the radius). The dark band moves along the spectrum (during rotation) one way or the other according to the nature of the quartz plate (dextrogyrous or lævogyrous). If the motion be sufficiently rapid for the impression on the eye to be continuous, one may trace out in space, or on a screen, opposite spirals. Curious variations are obtained by interposing plates of mica, gypsum, &c.—Study of telluric lines of the solar spectrum (Nice Observatory), by M. Thollon. With his powerful spectroscope, he has resolved the telluric groups B, D, and a of Ångström into their simple elements, separating these elements from each other, and from the other metallic lines.—On the liquefaction of ozone and on its colour in the gaseous state, by MM. Hautefeuille and Chappuis. They passed some highly ozonised oxygen (prepared by their new process) into a Cailletet apparatus. From the first strokes of the piston the capillary tube appeared azure blue. With several atmospheres' pressure the gas became of an indigo blue, the mercury meniscus looking steel blue through it. Sudden liberation from 75 atm. produced a mist, indicating liquefaction (300 atm. were necessary in the case of oxygen). Ozone is a little less easy to liquefy than carbonic acid. If the ozonised oxygen be not compressed slowly and in cold, the ozone is decomposed, giving a strong detonation and a yellowish flash. Thus the mixture contains an explosive gas.—On Brunton's tunnelling machine, by M. Biver. This gives an account of results with the machine as used in the lignite pits in the Fuveau Valley. It appears, *inter alia*, that of 51 horse-power of the motor only 12·4 was transmitted to the machine, 38·6 being lost.—Telescope with double action for pointing long-range guns, by M. de Broca.—On losses in manufacture of vinegar, by M. Garcin.

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